Editorial

INTERFERENCE with television programs, or TVI as it is generally known, may not be such a problem in Australia as in countries with a high population density and therefore more transmitters and receivers.

But it is something which must be faced and faced quickly if the main causes are to be eliminated before troubles arise, and if the sources of interference are to be sorted out so that we may view them in proportion.

Various conferences are being held and will continue to be held to this end, but there is one difficulty inherent in the adoption of the 49-56 Mc band for National stations in the capital cities.

To make way for this band, the amateurs have relinquished a band of 50-54 Mc which they have been using since the war, and have been granted instead a band from 56-60 Mc, the old pre-war "5-metre" band.

Now one of the features of amateur operation on 50-54 Mc of late years has been interstate communication during the summer months.

For hours and even days on end, amateurs in Australia and New Zealand contact each other during that period, and it has not been unusual to work stations in all Australian States and New Zealand districts in a matter of hours.

The amateurs have shown that transmitters using no more than 20-50 watts are heard over these same paths with all the impact of a neighboring amateur 100 yards away.

What will happen if stations in say Sydney and Melbourne, using this band, begin operating with power far in excess of that used by any amateur?

There will be places in each city where the interstate station will put down a much stronger signal than the local.

The situation is not nearly as acute on the higher TV bands, where this type of communication, due to tropospheric and ionospheric conditions, has been found a rarity rather than otherwise.

But even on these frequencies, amateurs have regularly held contacts up to 200 miles with low powered equipment.

It is inconceivable that possibility of this danger in the 49-56 Mc is not known to the Broadcasting Control Board. It is equally inconceivable that they have some unsuspected method of avoiding it, apart from allocating this channel once and once only.

If not, to use it in favor of the higher frequencies which are the logical home for services of the future, seems plain stupidity.

John Moyle

INDEX

RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE, S.M.I.R.E: (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS M.I.R.E. (Aust.)

TECHNICAL STAFF
REG RAWLINGS
PHILIP WATSON
L. VARADY
MERVYN HUDDLESTON

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OUR COVER PICTURE

The Australian Army is not backward when it comes to examining new ideas. The picture was taken during manoeuvres in which a small television camera was used to shoot a scene of men laying land mines the progress of which is being watched behind the lines.

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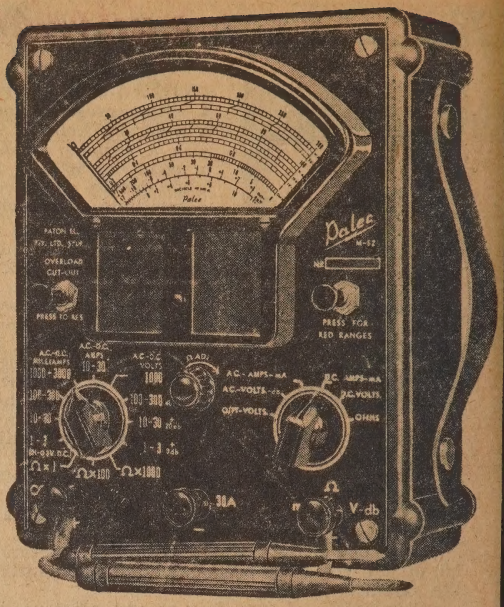

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Current A.C. mA.'s 0/1-3-10-30-100-300-1000-3000 Amps 10-30	10
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„ Ref. level 6 mW. in 600 ohms	3
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Current D.C. 0/1-3-10-30-100-300 mA.-1-3-10 amp.	9
Current A.C. 0/1 mA. (for use with ext. current transformers)	1
Ohms 0/1000: 0/10000: 0/1 megohms	3
Decibels Ref. level 1 mW. in 600 ohms	3
„ Ref. level 6 mW. in 600 ohms	3
Total ..	32

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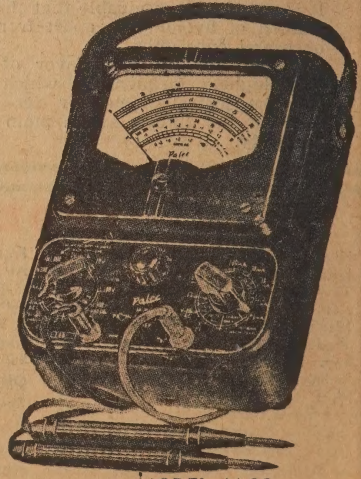

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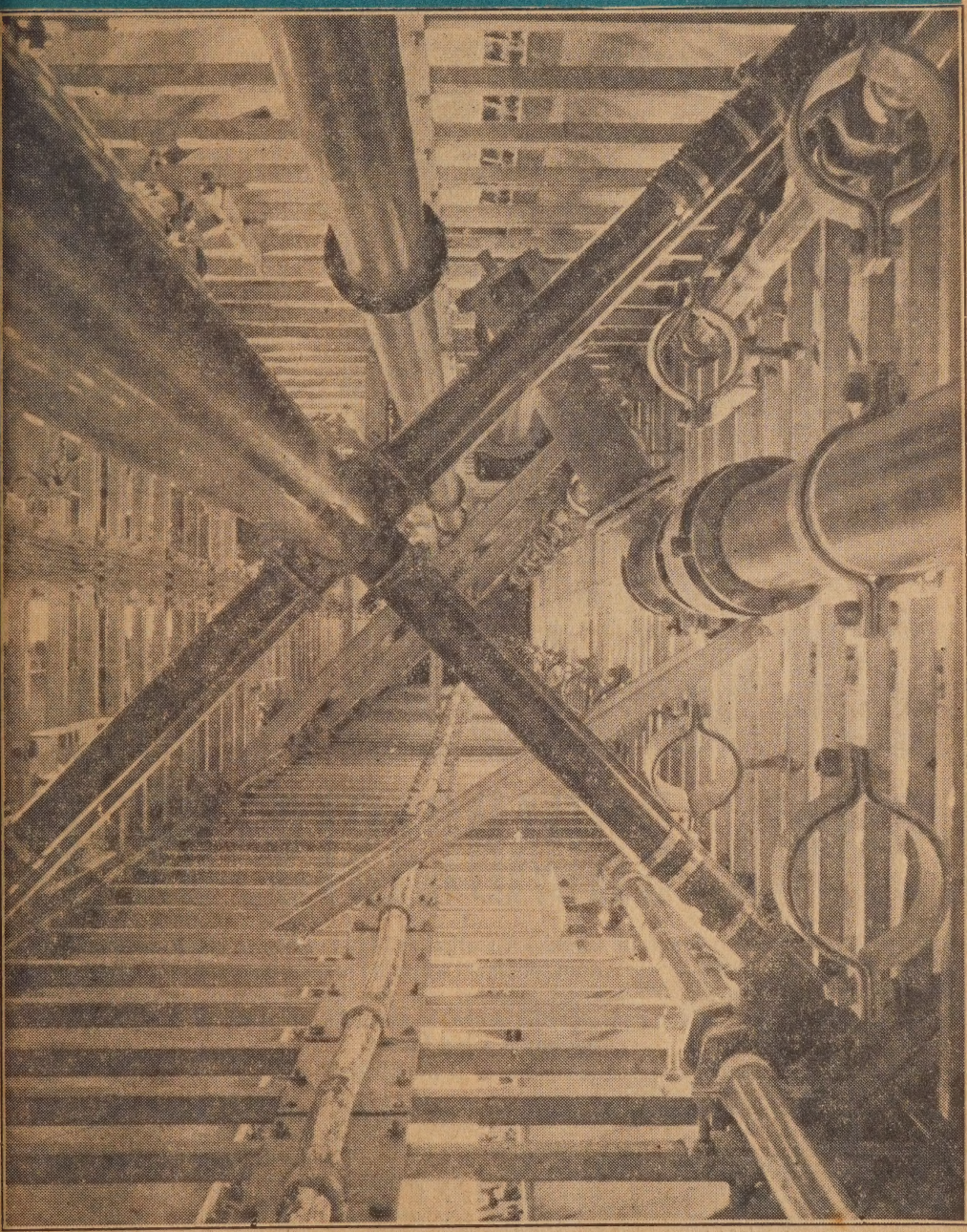
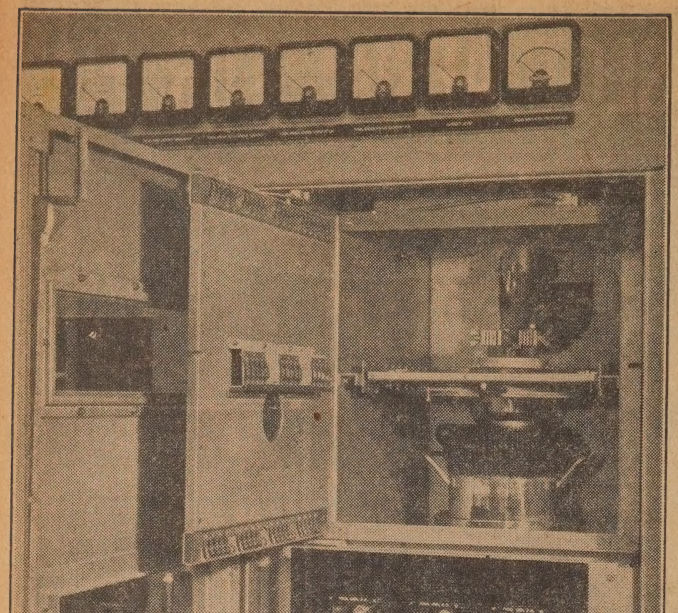
HIGH GAIN SLOT AERIAL FOR FM



A high-gain, cylindrical slot aerial is used at the new VHF station at Wrotham in England to give horizontal polarity. Looking upwards through the centre of the aerial we see a number of horizontal bars mounted behind the slots to increase the band-width of the aerial. The slots are fed with currents in phase and of equal amplitude, via the concentric feeders. (Story next page).



One half of the FM transmitter output stage at Wrotham which uses a pair of BR128 valves in parallel in a grounded grid circut.

BRITAIN BROADCASTS ON FM

The opening of Britain's first VHF broadcast station on May 2 marks an important step in the development of her radio services, a development which has made great strides in recent years. The adoption of a planned VHF network together with the introduction of commercial radio will have a big impact on the general radio scene, in which the influence of European broadcasting is a big factor.

THE proximity of the British Isles to Europe, in which there is an enormous number of stations crowding the broadcast band, led to very serious interference problems for listeners outside the immediate service area of the BBC transmitters. problems which can scarcely be realised in this country where distances between centres are so much greater.

Even here, however, it is considered by the PMG that no more stations can be safely accommodated on the band without undue interference, although this view is not accepted by all.

For this reason the PMG is prepared to license stations on the VHF bands where there is room for a large number having a local coverage.

Similar reasoning was applied by the BBC, which hopes to find in VHF broadcasting a valuable supplement to the broadcast band.

Investigation into the use of VHF was commenced about two years ago by the BBC, and early in 1954 recommendations were made to the Government that an extensive plan should be adopted and put in effect over a period of time.

The following statement issued b the BBC outlines the extent of th VHF plan.

"The Postmaster-General's an nouncement in July, 1954, that th BBC can now proceed with the firs stage of its plan for broadcasting o very high frequencies (VHF) wi be specially welcome to many lis teners who cannot now get goo reception of the Home, Light an Third Programmes—especially dur ing winter evenings when the want them most—because of fadin and because of interference fro foreign stations. The number o broadcasting stations on the Con tinent using the crowded mediu waveband continue to increase an the interference in this band likely to get worse rather than bette

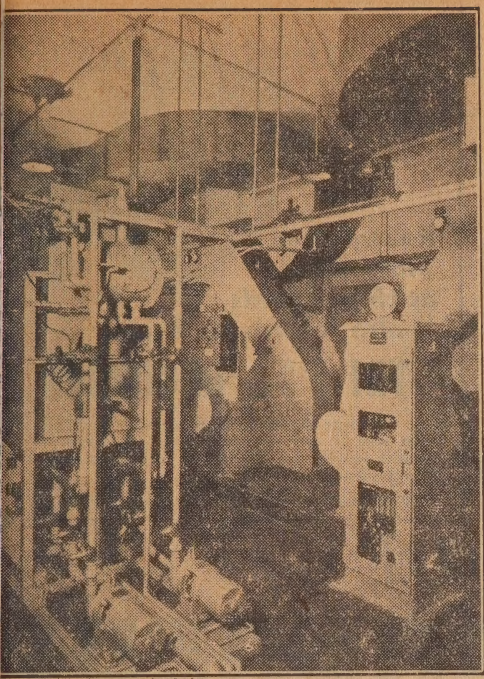
CROWDED BC BAND

"Some local improvements hav been made in the coverage of th Home Service by building low power transmitting stations in number of populated areas wher reception was unsatisfactory. Bu no comprehensive solution is prac ticable on these lines because ther are not enough wavelengths availabl to the BBC in the long and mediu wavebands to take any more station

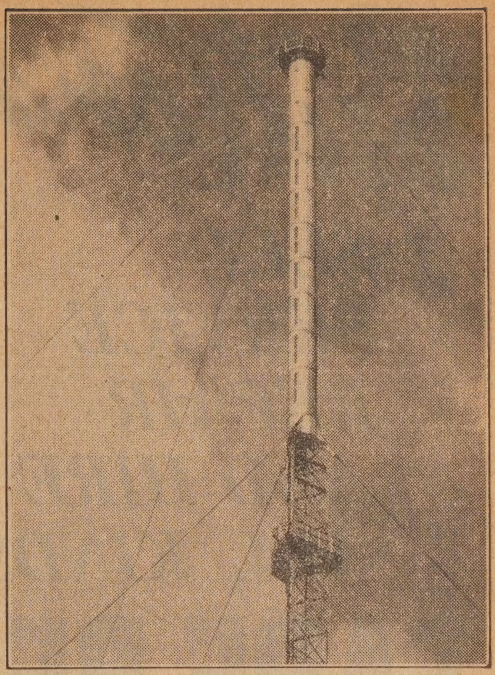
Every additional transmitter o the existing wavelengths tends t make reception worse in area already served, and the stage ha been reached where further addition are liable to do more harm tha good. Since more transmittin stations must be built if coverag is to be improved, it is necessar to use an additional waveband wher there is room for them to operate

"The plan is to build nine addit ional transmitting stations in th first instance. They will be high power stations and will operate i what is known as Band II, 88-9 Mc/s. that is, on wavelengths o approximately three metres.

"These wavelengths are much shorter than those used for mediu wave broadcasting, shorter ever than those used for television (i Britain); and this has a number o advantages. The very short wave



The valve cooling plant. Left, the supply unit for the water cooled transmitter test loads; centre and right, air blowers for cooling the valves in the FM and AM transmitters. The air can either be circulated round a closed system to raise its temperature quickly, or drawn in from outside the building. In cold weather the warmed air is discharged into the transmitter hall for space heating. Motor driven dampers operated by thermostats control the circulation of the air.



The VHF aerial and part of the triangular support mast. The aerial, which is shared by both transmitters, consists of 32 slots in the wall of a cylinder 110 feet long and 6½ feet in diameter. The slots are arranged in tiers, with 4 slots in each tier.

engths are much less liable to suffer interference from oreign stations than the medium wavelengths, and the act that the new transmitters will use 'frequency modlation' instead of 'amplitude modulation' will further reluce their susceptibility to interference.

"The effect of using it will be to ensure greater reedom from interference, whether from foreign staions, from electrical appliances or from motor cars, han is given by amplitude modulation.

"The nine stations to be built first and the approximate areas they will cover are as follows:—

"Wrotham: South-east England, including the Lonlon area and extending as far west as Basingstoke and Bognor Regis. Toward the north the coverage will ink up with that of Sutton Coldfield and Norwich. To he south and east it will extend along the coast of Sussex and Kent except for a small area embracing Deal, Dover and Folkestone.

WIDE COVERAGE

"Pontop Pike: The whole of the county of Durham nd the North Riding of Yorkshire, most of Northumberand and part of Cumberland.

"Divis: An area including the city of Belfast, and xtending to the borders of Eire in the south, as far s Cooktown in the west and Coleraine in the north, nd as far as the coast on the east.

"Meldrum: All those parts of Morayshire, Bannffhire, Aberdeenshire, Kincardineshire and Angus northast of a line running roughly from Elgin to Montrose.

"Norwich: The whole of East Anglia, joining the ervice areas of London and Sutton Coldfield in the outh and west and extending northward to Boston nd Skegness.

"South Devon: The whole of Devon and Cornwall, xcept possibly for small areas in north-east Devon and he extreme west of Cornwall.

"Sutton Coldfield: An area extending as far as Chester and Gainsborough in the north, Oxford in the south nd Welshpool in the west, and linking up with the

A co-aerial feeder system is used to the bottom of the mast on which is mounted the slot aerial.

Suttons

SELL SERVICE REPAIR AND HIRE ALL KINDS OF

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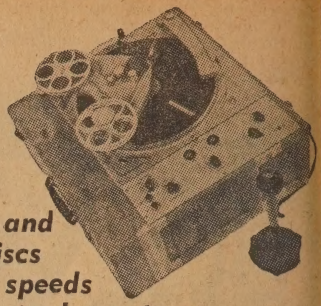

Records and plays discs at three speeds —also records on tape

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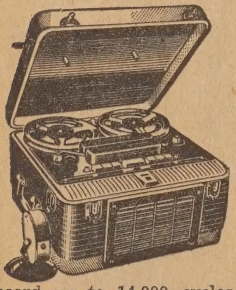
You can make Standard or Microgroove discs, record from tape to disc or vice versa. An in-built oval speaker enables this machine to be used as a public address system.

EVERY RADIO HOBBYIST SHOULD HAVE ONE.



Record up to 14,000 cycles on this latest twin-speed, twin-track

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High Fidelity TK819. Two hours on the one spool, without interruption. Other Grundigs available, TK9 (1¾ hours.) and 7001.

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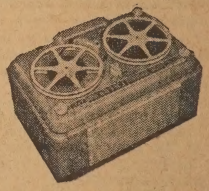
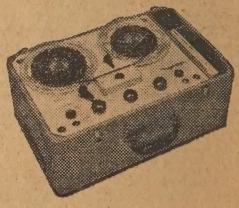
ALL ACCESSORIES ALWAYS STOCKED, including following tapes Magnetophon from £2/6/-; Phillips L. P. £3/5/-; Scotch £3/10/-; Magitape £3/10/-.



ELCON



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RADIO TUNER—4-valve wide-band super-heterodyne.

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POWER SUPPLY UNIT. A centralised power supply for the whole system.

TOTAL NUMBER OF VALVES USED—11.

Suttons PTY. LTD. (Inc. in Vic.)

OVER 100 YEARS OF SERVICE —YET AS UP-TO-DATE AS "HI-FI"

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rvice area of Norwich in the east. his area includes the Nottingham strict, where reception of the Mid- nd Home Service on the medium avelength is unsatisfactory.

"West Wales: The site of this ation has not yet been finally ttled, but it is expected to serve n area including the whole of the ast of Cardigan Bay and extend- g for a few miles inland.

"Holme Moss: The area bounded n the north by the line running oughly from Barrow to Bridlington nd on the south by a line from hyl to Cleethorpes.

PECIAL SETS

"Because the new transmissions ill use a different waveband it ill not be possible to pick them p on ordinary domestic receivers t present in use. Listeners who ish to take advantage of the new rvice therefore will have to equip emselves either with new receivers r with adaptors for use with their resent sets.

"Both new domestic receivers in- orporating a VHF range and also daptors will be produced by the adio industry by the time the new rvice comes into operation.

"It must, however, be made quite lear that the listeners who are sat- sfied with the reception they are ow getting will not need a new et, because the existing long and nedium wave transmissions will ontinue for many years yet."

In a later Press release, the BBC ives some further information and igures about the proposed stations, n particular the Wrotham trans- nitter.

A field strength map showing the performance of the Wrotham station. It indicates useful range in some directions of about 80 miles.

This map shows the anticipated coverage of the first nine FM transmitters.

The Wrotham VHF transmitting station will transmit the three BBC programs, throughout the normal hours of transmission—the Home Service on 93.5 Mc/s, the Light Program on 89.1 Mc/s, and the Third Program on 91.3 Mc/s.

The station is designed to radiate an effective power of 120 kW on each frequency and will serve the London area and South-east England within a range of about 50 miles. It is estimated that as a result of the opening of Wrotham, some 2½-million more listeners in this area will be able to hear the Home Service and nearly 1-million more the Third Program. If the effect of foreign interference on Home Service reception is taken into account, more than 5-million listeners to this program will be freed from the irritation of interference.

EXTRA LISTENERS

It is expected that VHF stations will be operating from Pontop Pike, Divis and Meldrum by the end of this year and that Wenvoe will be in partial operation. By the end of next year, Wenvoe will be completed and further stations will be built at Sutton Coldfield, Holme Moss, Norwich, North Hessary Tor and Blaen Plwy (West Wales). This will mean that VHF will be within reach of some 84 pc of the population of the British Isles.

When the first 10 VHF stations are completed, Home Service reception will have been made available to an additional 5,300,000 listeners, Light Program reception to an additional 2,900,000 and Third Program reception to an additional 11,800,000 listeners. All these listeners are at present out of range of the BBC transmitters and the figures do not include some 3½-4-million Home Service listeners whose reception is at present spoiled by foreign interference.

It will be seen from this information that the VHF plan is a very big one. Its acceptance or otherwise by the trade and the listeners themselves will be watched very closely in Australia, where the future of VHF will undoubtedly be raised again when TV has ceased to be a novelty.

(Continued on Page 27)

No. 82 TOOL CHEST

A comprehensive kit in a polished wooden cabinet. The three knives, Nos. 1, 2 and 5 are included and in addition a range of X-acto blades for cutting, carving, chiselling and many other intricate operations. No matter how difficult the task there's an X-acto blade for the job.

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A compact set containing the heavy duty No. 5 knife, 6 gouges and a selection of blades. Mounted for easy access on a platform block.

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Available from leading hobby stores and hardware dealers.

TV AERIALS ARE BIG BUSINESS

The production of TV aerials overseas is big business. Designed to make strong signals stronger, and weak signals strong, an almost endless parade of special designs thrust their odd-shaped arms into the sky from all angles and positions.

Moving with the times is this aerial specially designed for use with trailers, and this one is big enough for a home. It is lowered and locked in place when trailer is mobile.

THE use of a wide band of frequencies has complicated the roblem, as for best results the erials should be tuned to the freuency of the transmitter being reeived.

Some aerial arrays surrender to he inevitable and use a series of lements of the required length for ach band. Others have compronised by using broadband designs ntended to give good results from single assembly.

Typical of the first class is the atest production of an American rm—one of its "Minute Man" eries.

UICK ASSEMBLY

The name comes from the claim hat the aerials can be assembled nd installed in less than a minute fter unpacking.

Whether the man in our illustraion can perform this feat with his ultiple array might be open to oubt, but great emphasis is being laced on packaged aerials, which eed no skill in erection nor any pecial tools.

Everything is marked and cut to ize before shipment.

Corrosion is the enemy of aerial rrays, and care must be taken o resist it. The tubing used in this model has a finish consisting of a Vinsynite pre-treatment and pigmented coating with a tough, vinyl resin base to provide an almost impervious film on the surface of the metal.

It is claimed that the finish will not flake off, and it flows with the metal under cold forming and working.

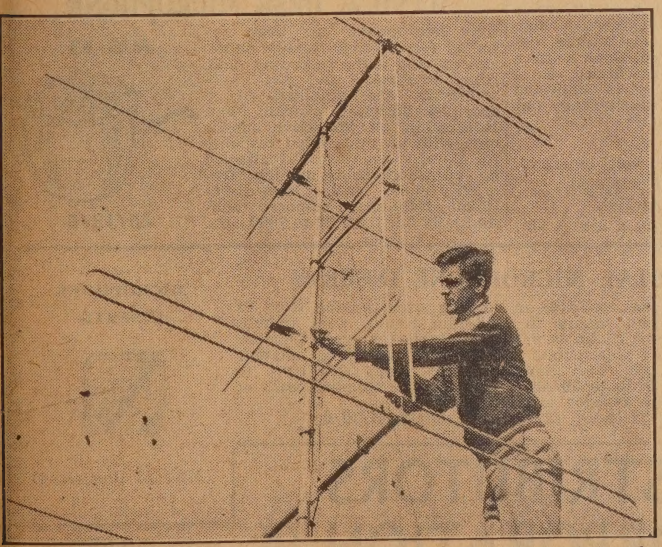
And for the luxury minded, there is the "Trailer-Tenna", designed specifically for trailer mounting, again without the need for mechanical or electronic knowledge.

FOR TRAILERS

Its supporting pole, available in various lengths, is fastened to a bracket, clamped to the chassis, and another near the roof. And there it can stay permanently, being lowered and locked into position when moving off.

It is claimed as an all-channel all-wave aerial for the VHF band, useable also on the UHF band.

It won't be long now before we will see structures of this kind sprouting from rooftops in our capital cities, although it may be some time before it will be worth mounting them on our caravans!



A multiband, weather-proofed TV aerial sold in USA in packaged form, which, it is claimed, can be assembled in less than a minute.

"ACOS" CRYSTAL MICROPHONES and MICROPHONE INSERTS

A Complete Range For Every Purpose

DESK or HAND MICROPHONE

MIC 36

Housed in attractive plastic case, this Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni- directional frequency response substantially flat from 30 to 7000 c.p.s. Recommended load resistance not less than 1 megohm dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor as required at a small extra cost.

£6/18/6

HIGH QUALITY MICROPHONE

MIC 16

Designed to meet even the most exacting requirements, this Microphone incorporates the world famous floating crystal sound cell construction. Its special characteristics are that its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise.

SPECIFICATION

Recommended load resistance—not less than 1 megohm.
Output level —65 db ref. 1 volt/dyne/cm².
Frequency response—substantially flat from 30 c.p.s. to 10,000 c.p.s.
Directivity—non-directional.
Size—2-1/8in spherical diameter.
Connector—Standard international 3-pin.

£24/19/6

GENERAL PURPOSE

MIC 35

The MIC 35, undoubtedly the best value ever offered, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5000 c.p.s.

£2/15/-

SPECIFICATION

Output level: —55 db ref. 1 volt/dyne/cm².
Cable—approx. 4ft. of co-axial supplied.
Weight—6ozs. unpacked, 7 ozs. packed.
Dimensions—microphone only 2¼in x 2⅛in x ⅞in.

TABLE or STAND MICROPHONE

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the quotation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost.

MIC 22

SPECIFICATION

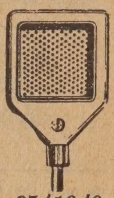
Output level = —50 db ref. 1 volt/dyne/cm².
Output impedance—equivalent to approximately 0.002 uF (0.8 megohm at 100 cycles).
Frequency response—substantially flat from 40 to 6000 c.p.s.
Recommended load resistance—not less than 1 megohm, dependent on low frequency response.

£9/18/6

LAPEL MICROPHONE

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

MIC 28



Output level—approx. —55 db ref, 1 volt/dyne/cm².
Recommended load resistance—5 megohms.
Frequency response—level throughout the whole of the audible spectrum.
Capacity—0.0015 uF. at 1000 c.p.s.
Impedance—100,000 ohms at 1000 c.p.s.
Cord—6ft. shielded cable.
Size—1-9/16in wide x 2¼in long x 5/8in thick.

£5/19/6

HAND or DESK MICROPHONE

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7000 c.p.s.

MIC 33

£6/18/6

MICROPHONE INSERTS

(MIC 32 illustrated)

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes ranging from as small as 15/16in square to 1-13/16in round, with various thicknesses from 7/32in to 9/16in. Suitable for every purpose such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2250 c.p.s. to 3500 c.p.s. at 5 db to 30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC 32 insert, £2/15/6; all others, £1/19/6.

MICROPHONE INSERTS

(MIC 23 illustrated)

VICTORIAN DISTRIBUTORS

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403 BOURKE ST., MELBOURNE

NEW U.S. TWO-WAY UHF PACKSET

This new packset, developed for use by the US Army, bristles with interesting circuit and constructional features. It will operate on frequencies as high as 400 Mc and is powered by a vibrator supply and a 6-volt rechargeable battery.

THE new equipment, known as AN/PRC-14, was developed primarily for work between troops on the ground and aircraft, thus filling a need highlighted by the increasing and close co-operation between air and land forces.

The use of UHF allows good signal strength to be obtained over direct paths with very little power. With an aircraft flying at 10,000ft a distance of 110 miles has been covered.

There are 23 sub-miniature valves in the equipment which is a transmitter receiver operating on any one of four pre-set frequencies within the band, in which 100 Kc spacing is provided for. This makes available 1750 different channels to be used as required.

Amplitude modulation is used with a transmitter power of 1 watt. Automatic modulation control prevents modulation in excess of 100%.

The receiver has AVC, a combined squelch and noise-limiting circuit, and a sensitivity of 5 mv. It delivers .25 watt into a pair of headphones.

HELMET GROUND PLANE

The standard US Army steel helmet is used as a base upon which the vertical aerial is mounted, and operates as a ground plane for the quarter-wave radiator. It is strapped to the helmet by a beryllium copper strip having a channel to accommodate the co-axial cable which feeds the aerial.

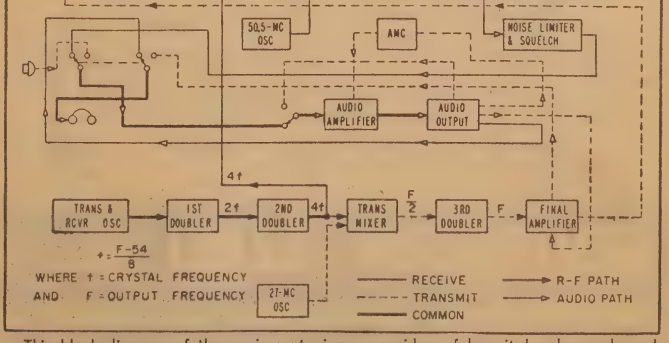
By a system of mixing in the transmitter circuit, it is possible to use the same set of crystals for transmitting as receiving on the same frequency.

The power supply for the equipment is operated from a 6-volt silver-zinc rechargeable wet battery of 20 ampere hours, with a vibrator pack to supply the high tension. It is strapped on the back of the operator, and the equipment itself on the front. The total weight is 26lb. It is waterproof and controls are accessible through watertight fittings and plugs.

Frequency selection is carried out by a single knob control linked to all the necessary selectors by a stainless steel strip. A drum section having four cam faces locks each setting of the four possible operating frequencies. Each of the linked control knobs has its own pre-set adjustments.

Construction is by sub-assembly throughout, many of which plug in to the appropriate sections of the main chassis to allow instant removal and replacement during maintenance.

The equipment is in two units—the power pack which is strapped to the operator's back, and the transmitter—receiver which is in front. The aerial is a vertical quarter-wave mounted on the helmet which acts as a ground plane. The total weight is 26lb. All units are watertight.



This block diagram of the equipment gives some idea of how it has been planned. There are 23 valves in all. Emphasis has been placed on the fewest possible stages and components fitted into the smallest space and with the lightest weight. Amplitude Modulation is used.

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- Turn-over Crystal or High Fidelity magnetic pickup .. . **£12/-/-**

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Small type for Garrard "S" Units etc -- -- -- -- -- 115/-

For Standard Player Units 125/9

For Velvet-Action Record Changers -- -- -- -- -- 150/11

Combination Record Player - Amplifier Cabinets -- -- 171/1

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in two-tone leatherette
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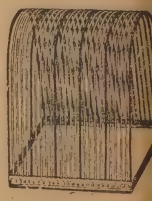
10in -- -- 53/- 12in -- -- 57/1

RECORDEX

The new improved gramo record rack



- Holds 25 or 50 10in or 12in records.
- Engraved easy to read index strip.
- Complete with index card and gummed Identification numbers of the records.

25 size -- -- -- -- -- -- 18/
50 size -- -- -- -- -- -- 35/

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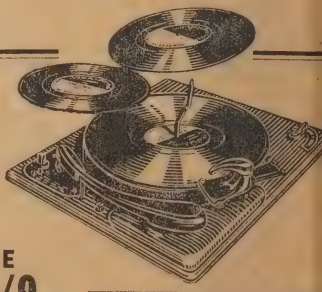
3 pce. top cowl complete with lead 113/-

HEAR MICROGROOVE AT ITS BEST WITH THE LATEST VELVET ACTION 3-SPEED AUTOMATIC RECORD CHANGER



Model 104—additional features of this new model include:

- One operation starts both motor and automatic mechanism.
- All controls centralised at front of changer.
- Pick-up may be handled in automatic position.
- Head and needles easily accessible.

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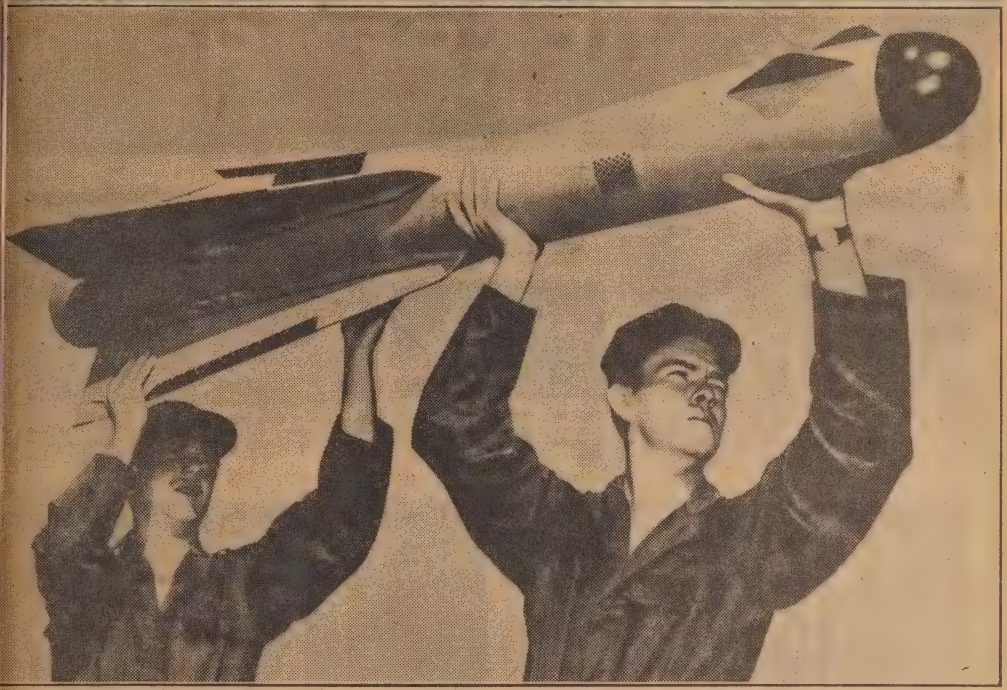
MAN'S DEADLIEST AIR WEAPON



This is the Falcon, the latest American air-to-air guided missile, designed to destroy enemy bombers before they reach their targets. Once it "sees" its prey, the Falcon is guided by its in built radar set, and will follow the bomber until it destroys it. A direct hit is not required. It is 6ft long and weighs 100lb.

And here is a giant radio "eye" worth half-a-million pounds being constructed for the University of Manchester at Jodrell Bank, near Cheshire, England. With a diameter of 250ft and a depth of 62ft, it is supported between 185ft towers. Total weight about 1500 tons carried by 12 bogies on a 310ft runway. The reflector shown is a model.

PRODUCING FREE AIR ELECTRONS

One of the biggest problems of physical research has been to get electrically charged particles into the atmosphere in sufficient quantities for experiments. For a long time, such experiments could only be carried out inside large vacuum tubes, where electrons and ions could be released and controlled much in the same way as it is done in cathode ray tubes.

AS it can be imagined, this method is rather cumbersome, because the object has to be introduced into the vacuum chamber, the chamber evacuated and the experiment carried out. The object of the experiment cannot be moved inside the tube and results were not known until it has been removed from the chamber.

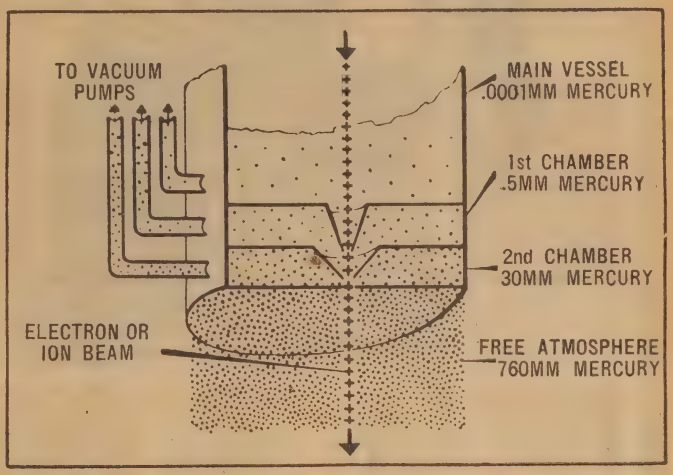
Only one method by which a limited number of electrons could be obtained in free air, is known as "Lenard's Window" method.

Electrons are accelerated in a special cathode ray tube, which is provided with a tiny window of approximately 1-16in diameter. The window is made airtight by a small wafer of mica, or aluminium foil. Electrons of very high energy (25,000 EV or more) are able to penetrate through such windows, if the thickness of the wafer is not more than .002 mm.

THIN, BUT THICK

This, however, constitutes the minimum thickness of material which will withstand the terrific pressure difference existing between the two sides of the window. A thickness of .002 mm may seem to be a very small, but it is probably easier to ride a motorcycle through a brick wall than to get a heavy particle such as an ion through the window.

Also, a stream of electrically-charged particles constitutes an electric current, with its associated heating effect, so that an excessive amount of such particles could easily melt the window.



Cross section of the air-lock showing the arrangement of the pressure chambers.

During the early twenties attempts have been made to use a small hole in the tube rather than a mica or aluminium window, the influx of air being continuously countered by a vacuum pump. Several of these chambers in series, each maintained at a successively higher pressure, did enable some heavy particles to enter the atmosphere, but for various reasons the experiment wasn't a success.

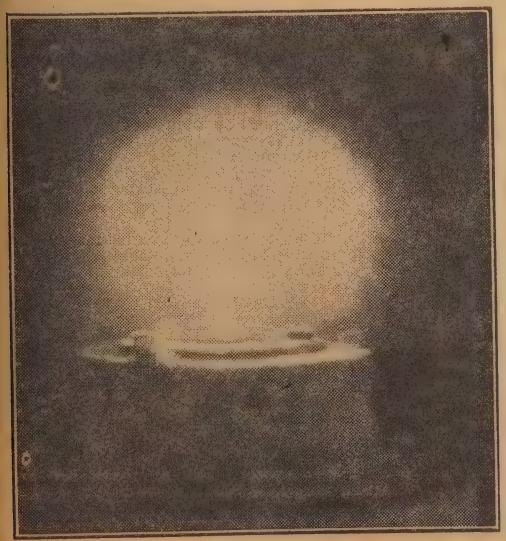
Professors E. Schopper and B. Schumacher, of the Stuttgart Polytechnicum, have now succeeded in constructing an "electron gun" on a similar principle. Their "Dynamic Stepped - Pressure Airlock" enables scientists to obtain electron or ion beams of up to .5 Ma intensity in free air.

Careful calculation of jet sizes, pressure relations and air streams have resulted in an excellent vacuum in the main vessel, still permitting window dimensions of .3 mm diameter.

Thus, a new tool for science and industry has been created. With beam intensities previously unattainable one can weld subminiature assemblies, or bore holes of microscopic dimensions. Solids can be examined for their x-ray spectrum, when excited by an electron stream.

This last possibility is particularly important, as before the x-ray spectrum has been absorbed by the walls of the vacuum chamber.

Chemical analysis by decomposing compounds in the electric beam also becomes reality, something that has never been done before.—Orion.



The stream of electrons issuing from the air-lock is sufficient to ionise the air and cause it to glow.

★ ★ ★

The famous black stone in the north-east corner of the Kaaba, shrine of Mecca, is known as Hajar-al-Asward. According to legend, when Abraham wished to build the Kaaba, the stones came to him of their own acord, and he commanded the faithful to kiss this one. It is believed to be a meteorite and was first said to be white as milk, but became black through the sins of the millions that had kissed it. When the Moslem pilgrim has made his seven processions round the Kaaba, he goes to Mount Ararat, and before sunrise enters the valley of Mena, and throws seven stones at each of three pillars, in imitation of Abraham and Adam, who thus drove away the devil when he disturbed their devotions.

Response to some rays is terrific. We are not sure whether these men are trying to get out the door or preventing others from getting in! At any rate the Johnny Ray was to blame and the place is the Kingsford Smith Customs House.

RAYS THAT CAN KILL OR CURE

Scientists are always finding out new things about rays. They can use them to cook food, to take pictures, to see what goes on inside us. The latest product of civilisation, the Johnny Ray, has produced a terrific impact, particularly on the young, but indications are that it may not stay the course.

by Calvin Walters

OF all the rays which abound in nature perhaps the most versatile are those known as infra red rays.

The number of different rays known to science is large. There are the light waves, ultra violet rays, heat rays, infra red, x-ray, cosmic, the rays from radio activity (alpha, beta, gamma, &c.).

Then there is the Johnny Ray which some people think is not a natural phenomenon, while others think it is. It depends whether or not you are "sent".

There is also the sting ray, associated possibly with those who make out your bills, the hooray and the foray, found at football matches and political meetings and lastly Dalray, found at racecourses.

If you can think of any more it doesn't matter anyway (I was nearly tempted there but I'll leave it alone).

ALL ARE USEFUL

Now if you can get back to the drift of this dissertation we will find that practically all the rays mentioned at first are useful to mankind in some way or other.

Light rays are, of course, most widely know, even if only to find out what time it is. There is no need to enlarge on light rays.

Color, of course, is a light ray of a special wave length according to the color we see.

Those which interest us most at this stage are the infra red rays.

Now before we go any further, we must be reminded once more of the meaning of the term Angstrom Unit. This is named after a scientist of that name and is a measurement of one 10-millionth part of a millimetre. Fairly small, isn't it?

All rays are measured by Angstrom units designated by the symbol A.

To give some idea of the varying lengths of rays, the following is of value:

The visible spectrum, that is the band of colors seen when white light is split up through a prism, runs from violet to deep red. The wave lengths of the various colors is as follows:

Violet	3900—4400A.
Blue	4400—4900A
Blue/green	4900—5100A
Green	5100—5500A
Yellow/green	5500—5750A
Yellow	5750—5900A
Orange	5900—6300A
Red	6300—7000A
Deep red	7000—7600A

It will be seen that the wave lengths increase in length as we progress from violet to deep red.

Below the violet are the ultra violet rays of wave length 1000-3900A. Below this again are the x-rays and radio active rays—alpha, beta, gamma, &c.

Above the deep red are the infra red of wave length 7600—about 10-millionA, while farther still are the radio waves of wireless, and so on.

It will thus be seen that the infra red rays have a very broad spectrum from 7600 to 10-millionA.

If a sensitive thermometer could be placed just beyond the deep red end of the spectrum, a slight rise in temperature would be noticed.

Thus infra red rays are generally considered as heat rays.

MOST PENETRATING

When these rays fall upon an object, nothing happens as far as the eye is concerned, for no visible phenomena are produced. Rather are these perceptible only by the sense of feeling by the heat generated.

However, infra red rays have the interesting property of being able to penetrate various substances which are opaque to the visible light rays. Thus its first use was in photography.

By means of this type of photography, pictures may be taken through mist and fog and even in darkness. The penetrating power of the rays makes this possible.

For photographic work special plates and films are used which are sensitive to the rays, and great precautions must be observed in developing them in order that unwanted rays may not affect the films.

By far the greatest value of the infra-red radiation lies in the in-

A particularly fine piece of landscape photographed with infra-red film. Believe it or not, those distant mountain peaks are 60 miles away. This picture could have been taken equally well through a morning mist.

dustrial field for the production of radiant heat for drying and heating.

Heating in some form is perhaps one of the most widely used of industrial processes whether it be used for cooking, drying, melting or baking.

HEAT REGIONS

Most of the applications of heat lie in the regions of medium temperatures from about 50 degrees to 400 degrees F.

For the purpose of heating, three different methods can be employed, namely conduction, convection and radiation.

The first, conduction, can be carried out by placing the article on a hot plate so that the heat is transferred.

In convection heating the article can be placed in a current of hot air, and by radiation the article can be placed in the sun or subjected to the heat from an electric radiator.

Infra-red rays are radiant heat and the wavelengths generally used are those between 7600 A Units and 12,000 A Units.

At these wavelengths infra-red rays obey the same laws as do visible light regarding reflection, transmission and absorption. They travel at the same speed as visible light and travel without loss through the air.

Infra-red rays can be reflected from polished surfaces and two of the best of these are gold and aluminium.

The method of generating radiant heat is simple. Any substance which has been raised in temperature above absolute zero (about 480 degrees below freezing point) will emit radiant heat. The higher the temperature the shorter the wave length of the emitted rays.

The sun gives off radiant heat and so does any fire or a match or the end of a cigarette. So does Marilyn Monroe I suppose. I wouldn't know.

FAST HEAT

Radiant heating is about the fastest kind of heating available for the following reasons.

It is well known that heat is transferred from a hot to a cool body at a speed depending on the difference in temperature between the two. In an ordinary baking oven for enamelling purposes the convection principle is used where hot air passes over the article to be treated. The temperature of the air in the oven would possibly be about 300 degrees F.

If a piece of sheet metal is placed in the oven it is possible that it may be at room temperature when placed in the oven. The difference in temperature between the oven and the metal is 240 degrees.

At the beginning of the heating process the heat transfer is rather fast but as the temperature difference becomes smaller the rate of heating is reduced.

This then is the principle behind heating by convection.

Heating by radiation however is very much faster because if a source of heat can be obtained which in itself is extremely hot (the heating element of a radiator or the filament of an electric lamp) the difference in temperature between the heating source and the article to be heated is so great that it takes a very short time to raise the article to a given temperature because the rate of transfer is much faster.

Take the filament of an electric lamp. It is about 3500 degrees F. With an article to be heated having an initial temperature of 60 degrees as before, the difference between them is always greater than 3000 degrees. Therefore the rate of heat transfer is very high.

USEFUL INFRA-RED

It would be theoretically possible to raise the article to the same temperature as the filament of the lamp but as the article increases in temperature it also radiates heat and these losses bring about a balance where no further rise in temperature is possible. The limit in enclosed ovens is about 400 degrees F.

It has been found that the most useful wave lengths of radiant heat or infra-red rays lies in the region of from 7600 to 12,000 A Units and to obtain the maximum amount of radiant heat at these wave lengths the source of the heat must be greater than about 3000 degrees F.

The obvious source was therefore an electric lamp, the filament of which can be used at this temperature.

Ordinary lamps as used in the home can be used for this purpose to a limited extent with a reflector of gold or aluminium, and convert about 85 pc of the power input into infra-red radiation.

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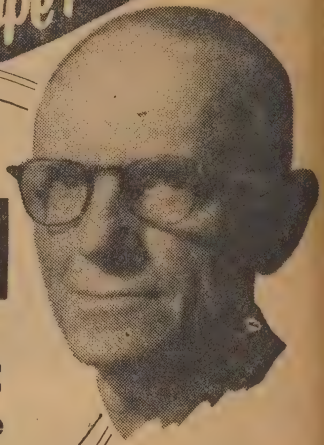

Mr. H. K. R. Thomas, *Chief Sound Recording Engineer at 2GB Macquarie.*

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6. Minimum distortion—maximum signal to noise ratio.

7. Unequalled uniformity reel to reel.

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As, however, the filaments of these mps operate at a temperature reatly in excess of 3000 degrees F. eir life is short and at this high mperature the radiation is at a ave length lower than the desired ,000 A Units.

The latest developments have een along the lines of a new type f lamp which has a tungsten fila- ent of extremely small volume con- ntrated at the focal point of an ternal parabolic reflector on the side of the glass bulb.

This dispenses with the external eflector required with ordinary mps and as a result the greater art of the radiant heat developed concentrated in a cone with an ex angle of 30 degrees.

CONCENTRATION OF HEAT

This enables the radiant heat eveloped to be concentrated on to he required area.

These lamps consume 250 watts f power and have a life of about 000 hours. Quite a big improve- ent over the previous service mps.

A useful feature of this type of adiant heating with infra-red rays s the usefulness of the rays in pene- rating materials normally opaque o visible light rays.

An example of this is the use of he rays in ovens for drying enamels. n the old convection ovens ment- oned above the heat is absorbed rstly by the outer layer of enamel. his layer dries first and from it the eat is transferred to the underlying ayers but in drying as it does the uter layer slows down the drying f the inner layers by providing an bstacle in the path of the heat.

With infra-red lamps however the eat penetrates throughout the ntire thickness of the enamel. In ractice it has been found that the etal on which the enamel is paint- d heats faster than the enamel so hat the enamel actually hardens rom the metal outward thus avoid- ng the formation of an outer layer of ard enamel as with convection eating. This speeds up the drying ime to a fraction of that required y convection drying.

DRYING TIME

Drying time is further shortened y the fact that when the lamps are switched on the heat is immediately available. There is no time taken up waiting for the oven to heat up.

In practice the lamps are usually arranged in banks according to the use to which they are to be put.

For drying small areas one or two lamps mounted on a portable stand is very useful but in large instal- lations anything up to 150 lamps may be used.

These are usually contained in per- manent ovens. The ovens are some- times lined with sheet aluminium, the front of the lamps only pro- truding through the sheet aluminium sides. In this way advantage is taken of multiple reflections inside the oven and the reflected heat is not lost through the gaps between the lamps.

Sometimes an oven is made large enough to cover a motor car. The oven is raised vertically by a winch and lowered over the freshly painted car. By these means the lacquer is completely dry in three minutes.

Your girl-friend's hand may look delightful with its rings and bracelets, but to the x-ray camera it is merely a skeleton.

For stove enamelling such articles as tubular steel furniture the articles enter the oven at one end and slowly move through the oven emerging from the other end in six minutes completely dry.

BLUEPRINTS

Banks of lamps are often used for drying out blueprints and other types of copying papers after de- veloping and washing. The printing paper is drawn continuously and slowly under the lamps by driving rollers and the output of the machine is 200 square feet per hour.

In printing works gummed en- velopes are drawn by means of a belt under a bank of infra-red lamps. This dries the gum in 50 seconds.

In garages where motor car bodies have to be touched up after a drive through Sydney or Melbourne dur- ing business hours or a trip on a Sunday a bank of seven lamps on a portable stand will dry a patch of laquer in three minutes. Twenty cars an hour. One hundred and sixty cars a day. That would be about right for Sydney I think.

In dehydration—that is the evapor- ation of water from articles such as textiles, tobacco leaf, fodder, foun- dry moulds, ceramics, electrical equipment, salt, flour and so on, infra-red radiation has outstanding advantages over the old method of standing overnight to dry or the use of hot air ovens.

In evaporating, water must absorb a constant amount of heat no matter how it is applied. In drying natur- ally, this heat is extracted from the air and this transfer when the air and the articles are approximately the same temperature is a slow pro- cess. Radiant infra-red heat is avail- able directly and the drying time is much faster.

In addition the rate of evaporation below boiling point depends on the relative humidity of the air next to the wet material.

In still air a layer of saturated air

(Continued on Page 112)

Technical Review

G. E. SHOWS LIGHT AMPLIFIER

The true amplification of light is something which so far has eluded the efforts of our scientists and engineers. Many have been working at the problem for many years, and only recently it was mentioned by David Sarnoff of RCA as one of the problems his company hoped to solve in the near future.

BUT according to a report in "Radio Electronics" the American GE company has been successful in light amplification through the development of a new phosphor cell. The full practical value of the experiment described here isn't clear at the moment, but at least it does indicate the paths along which some further research can be expected. Light amplification would be of the greatest value in many fields.

Many exciting possibilities are envisioned as the result of a recent demonstartion of General Electric's new "light amplifier," a unit which amplifies light without the use of electronic tubes.

Although this discovery may be the clue to achieving "picture-on-the-wall" television screens, and to advancing the art of x-ray fluoroscopy, photography, "seeing-in-the-dark" devices, and other developments involving reproduction of picture images, the company is cautious about predicting any immediate application of this technique.

Dr. F. E. Williams (right) and D. A. Cusano demonstrate the amplification of light.

Interest in this phenomenon lay not so much in its immediate use but in the fact that scientists are now able to increase the brightness of a projected photograph by passing an electric current through a special phosphor cell which is used as the viewing screen.

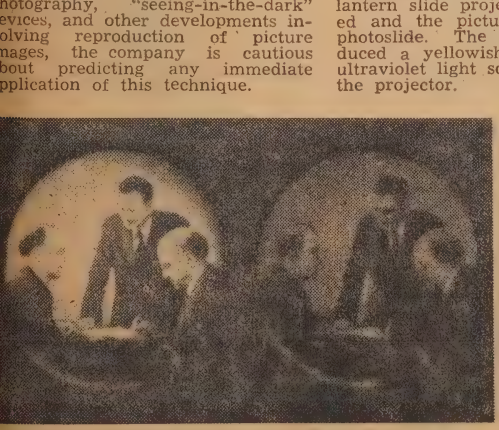
In the demonstration an ordinary lantern slide projector was employed and the picture was a regular photoslide. The small screen produced a yellowish image when an ultraviolet light source was used in the projector.

As the voltage on the specially prepared screen was increased, the picture became bright in the manner usually achieved either by increasing the intensity of the projector light or by opening the lens aperture.

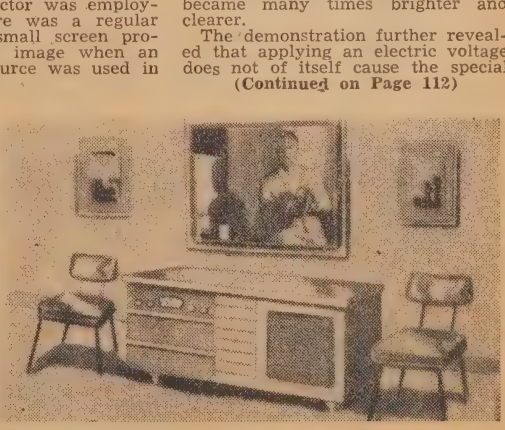
Neither the light nor the lens was altered, however, and the picture — which was first barely visible — became many times brighter and clearer.

The demonstration further revealed that applying an electric voltage does not of itself cause the special

(Continued on Page 112)



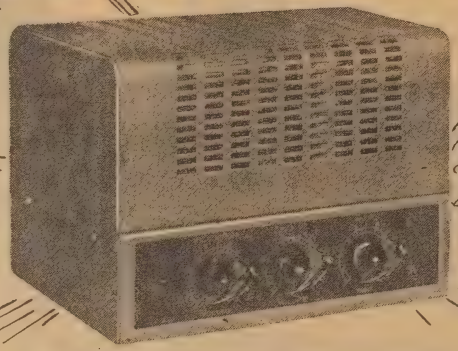
Not much has been published to date on the idea of using a wall screen for direct viewing in place of our conventional picture tubes. Many major electronic companies are at the present time working on the idea which will, no doubt, become a reality in the future. This new light amplifier may be a clue to "picture-on-the-wall" developments, according to G.E.



Two photographs printed simultaneously from negatives made consecutively on a roll of 35 mm film. The increase in brightness visible in the photograph at the left is due entirely to the light amplification technique which involves a combination of ultraviolet light, a special phosphor, and the application of a voltage to the phosphor to give a light increase of ten times.

You can take it with you!

PHILIPS PORTABLE P/A SYSTEM



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Philips Microphone . . . Type 1108

Crystal Type designed for high quality performance. The response characteristic is from 70-7000 cycles with omni-directional pick-up pattern. Other types available also at a slightly higher price. Adjustable Floor Type Microphonic Stand Included!

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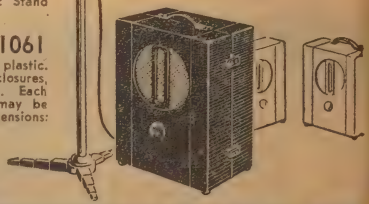
Beautifully made and covered with washable plastic. When opened separates into two speaker enclosures, each housing an 8in. Public Address Speaker. Each enclosure will stand without supports or may be hung on a wall or similar place. Dimensions: 13in. wide, 16in. high, 10in. deep.



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ELECTRONIC TYPEWRITER WORKS BY SPOKEN WORD

A dictating machine which acts as its own stenographer would really be something in the business world, although it would take some of the glamor from an otherwise dull routine. But it would undoubtedly speed up office work and find many new uses. This interesting clipping indicates that it might not be so far away.

AN inventor, M. V. Kalfaian, of Los Angeles, California, has been awarded patent 2,673,893 for "Phonetic Printer of Spoken Words".

According to this inventor, an analysis of speech waves shows that the complex waveforms associated with speech patterns of male and female voices can be brought into a common frequency band by frequency-changing techniques. Following this, certain areas of the common frequency band are separated into selected areas wherein the standardised frequencies of the frequency-changed speech patterns may be broken down into four ranges.

The output signals in each of these ranges is rectified and applied to a ratio-metering device, the output of which, in turn, is applied to a modified electric typewriter of the type now familiar in computer apparatus.

BLOCK DIAGRAM

A simplified block diagram of the invention as described above is shown in Fig. 1.

A more elaborate block diagram is given in Fig. 2. The speech wave is amplified, broken down into the common frequency bands where major peaks are detected and appropriate pulses generated.

At the same time the four peak samplers are operated to separate the distinguishing characteristics of the phonetic speech patterns and the outputs thereof mixed with delayed pulses from the peak separation and differentiator networks into four storage devices. Four discharging circuits control each of the storage units to apply appropriate pulses to the cathode-ray device of the ratiometer where the signals generated are gated and sampled.

WORD SEPARATOR

Appropriate combinations of signals operate the combinations of typewriter keys to print phonetically the words spoken into the speech input.

Some of the circuits of this invention are of particular interest. One of these is the word separator shown in Fig. 3.

The circuit consists of a rectifier and RC network that produces output signals during spoken words. The time constant of RC is adjusted to equal about the shortest time period that a speaker may pause between spoken words. All higher frequencies are cut out. This results

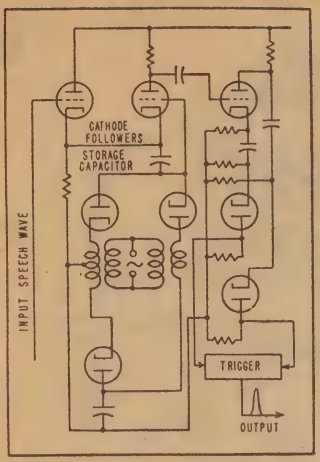


Fig. 1—Diagram showing the general nature of the speech typewriter.

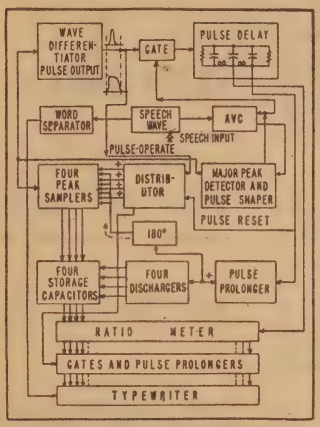


Fig. 2—A block diagram showing details of speech analysis equipment.

in a series of square waves of varying lengths that move the typewriter carriage one step forward for each spoken word or in some cases each syllable.

The circuit of a wave differentiator is shown in Fig. 4 and the ratiometer in Fig. 5. — Electronics.

CHEAP AND FAST

SMALL intricate aluminium parts can now be cast in plaster of Paris molds to eliminate costly machining methods.

Plaster of Paris molds have long been used in the manufacture of aluminium parts, but up to now the process was to expensive and not accurate enough for miniature parts.

The new process for making small aluminium and magnesium parts is much faster and cheaper than older methods, and the parts obtained require little or no machining.

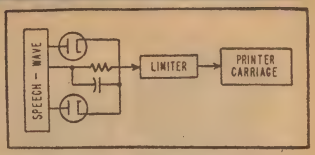


Fig. 3—Word separator unit spaces by moving carriage.

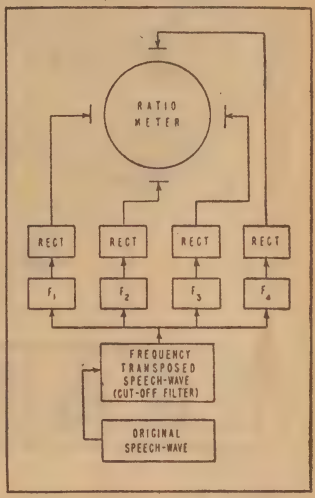


Fig. 4—Wave differentiator circuit.

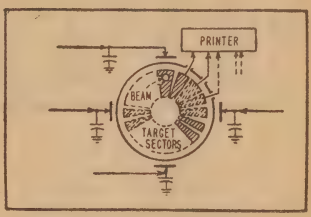


Fig. 5—Ratiometer is based upon cathode ray tube.

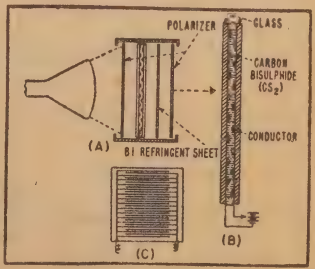
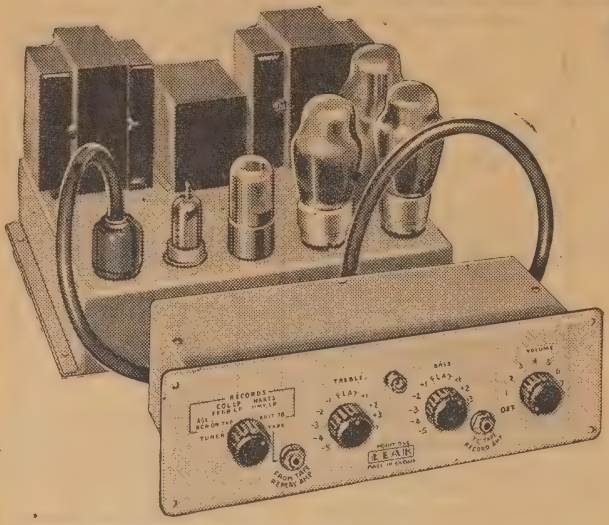
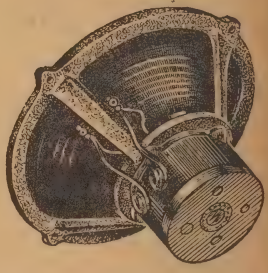


Fig. 6: Polariser is placed in front of TV screen (A) and comprises carbon bisulphide window (B). Grid structure is shown at (C).

A Combination that cannot be bettered *at any price..*





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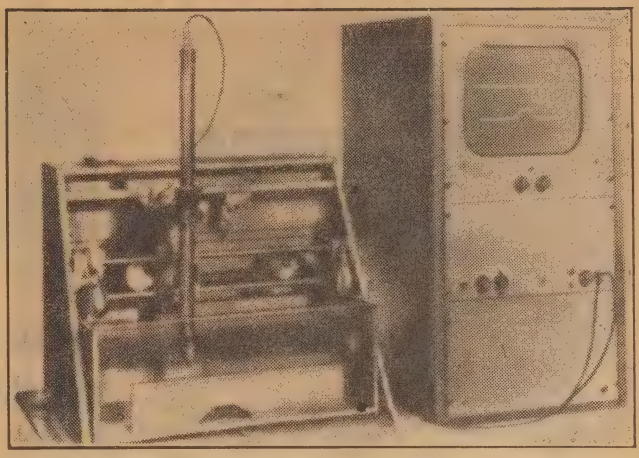
SCANNING TECHNIQUES USING ULTRA-SOUND

Ultrasonic scanning techniques are among the most important methods of locating hidden flaws in materials such as brass, steel, aluminium, plastics and ceramics—many of which could not be satisfactorily tested with x-rays or other means.



Material immersed in tank is scanned, the image appearing on the C-R tube screen.

THE use of instruments using this principle has considerably reduced the quantity of casting failures in service. They are also a valuable tool for the development of new casting and other manufacturing processes.

Initial efforts to use ultrasound for industrial test purposes in both the United States and Europe consisted of projecting high-frequency vibrations from a transducer through a material, to a receiving device—much the same as x-rays are used. This was an effective method of testing relatively thin sheet or plate materials, because the intensity of ultrasonic vibrations penetrating a material is proportional to the density (and thus the quality) of the material.

It was not a practical method of testing most materials because sonic impulses travelling from one medium into another have a tendency to become echoes and thus lose their ability to penetrate. For example, if an ultrasonic impulse is sent through a heavy forging, much of the energy of the impulse will be lost when:

HEAVY FORGINGS

1. The surface of the forging that is closest to the transducer or generator produces an echo.

2. Flaws of foreign matter, if any, within the forging produce echoes.

3. The surface of the forging farthest away from the transduter or generator produces an echo.

Industrial engineers soon began to investigate the possibility of using ultrasonic echoes to determine the presence or absence of flaws in various industrial materials.

This was a difficult task, despite the fact that ultrasonic echo devices had been used as depth finders aboard vessels since about 1912, and much had to be learned about the acoustical properties of numerous materials.

The first industrially practical echo test devices were developed almost simultaneously in England, Germany and the United States during World War II. Most of these were similar to, if not precisely the same as, the Ultrasonic Reflectoscope produced by Sperry Products, Inc., Danbury, Conn.

This instrument generates ultrasonic impulses by using radio-frequency current to vibrate a piezo-electric crystal (usually a quartz crystal, although barium titanate crystals have been used).

Impulses with frequencies of 1 mc or more are commonly used, since echoes of maximum intensity cannot be produced with ultrasounds at lower frequencies. The exact frequency used in any given circumstance depends on the ability of a test material to pass a sonic impulse with maximum efficiency; no two different materials have the same acoustical properties.

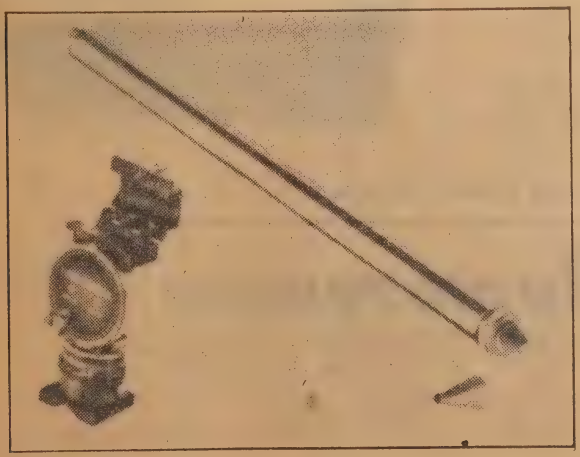
The metal holder for the Reflectoscope's output crystal is usually held in close contact with the surface of a material to be inspected because high-frequency ultrasound will not penetrate the thinnest layer of air. However, the need for close contact between th crystal and a test specimen has been eliminated in many cases by immersing both units in a fluid such as water.

After the energy from each ultrasonic impulse is reflected, the output crystal of the Reflectoscope serves as a detector, making it possible to amplify each echo and produce visual signals on the face of a C-R tube. The positions of the signals or visual images on the face of the tube vary with the amount of time required to produce different echoes.

CENTRE IMAGES

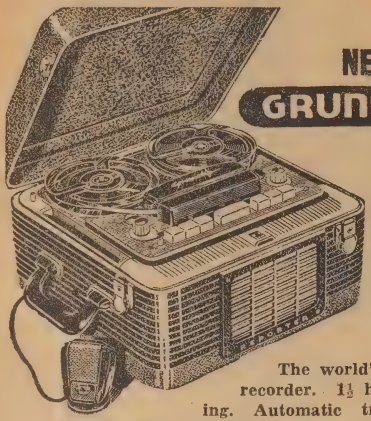
Therefore, signals on the extreme right or left side of the tube indicate nothing more than the existence of two material surfaces; images near the centre of the tube indicate internal flaws.

Devices of the Reflectoscope type have saved many millions of dollars for railways and airlines during recent years by locating small flaws in rails, axles, crankshafts and



Components of search unit. Quartz crystal is mounted on right-hand end of long metal tube. Cone-shaped unit fits over tube and beams ultrasound. Remaining parts used to align tube and material.

PORTABLE EQUIPMENT FOR MUSIC ENTHUSIASTS



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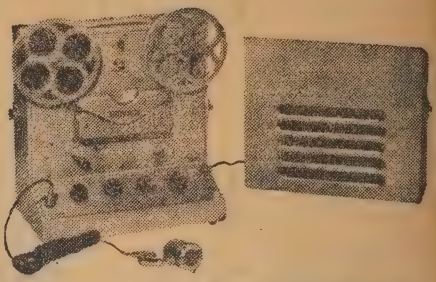

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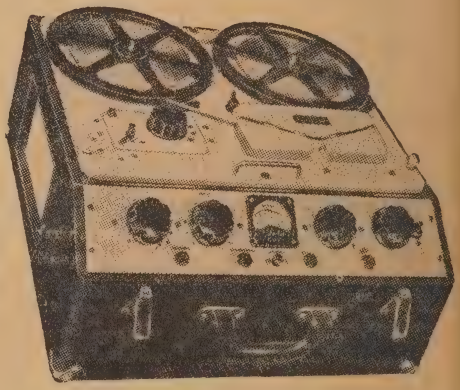

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THE AUDIOTORIUM

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other components whose failure could cause serious accidents.

Similar defects couldn't have been detected with x-rays in most cases because they were either too small to vary the density of x-ray pictures or they existed in materials such as lead and brass alloys which cannot be penetrated by x-rays.

Yet, for many industrial purposes, ultrasonic instruments had one serious shortcoming: They couldn't be used to distinguish small, unimportant flaws from the major defects which can cause some articles to be virtually useless.

This shortcoming has now been eliminated by a television type scanning technique that makes it possible to observe on a C-R tube a complete cross-sectional image of a test specimen—a view that could otherwise be obtained only if the specimen were cut into two pieces.

An ultrasonic search unit is moved over the surfaces of a material specimen so that as many as 1000 energy impulses per second can be echoed, amplified and indicated on a C-R tube screen. A phosphor coating on the screen causes the visual signals to glow for many seconds after they are produced.

IN WATER TANK

As a rule, both the output end of the search unit and the test specimen are immersed in a water-filled tank so that ultrasonic impulses and echoes can be transmitted and received without running the risk of damaging a thin quartz crystal by rubbing it over a rough-surfaced test specimen. Where an immersion tank is impractical, as in testing underground gas pipes for corrosion, special fixtures transmit the ultrasonic impulses to the surfaces of test specimens through a stream of running water.

As much as 90 pc of the energy transmitted by the search unit is echoed when it comes in contact with the nearest surface of the test specimen. This produces an intense reference line which indicates the relative position of that surface on the C-R tube screen.

Energy entering the test specimen is echoed either by flaws or the farthest surface, and the visual images produced on the screen indicate the precise shape and locations of flaws below the specimen surfaces.

Scanning movements of the ultrasonic search unit can be produced by either manual or mechanical means, and the position of the search unit can be varied to beam energy at a specimen from different angles. "Angular beaming" is essential to the accurate evaluation of many flaws. For instance, an internal crack which appears to have pinpoint dimensions if it is viewed from one end may turn out to be a serious flaw when scanned from a different angle.

VARYING SIZES

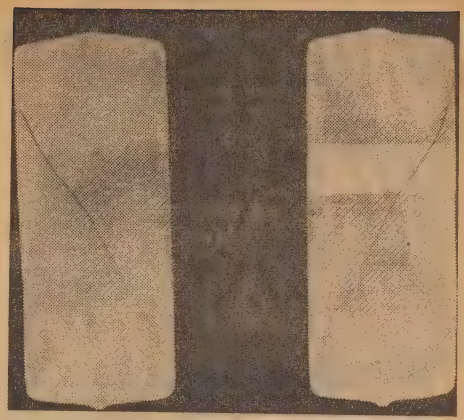
The images produced by rapid scanning may be either larger or smaller than the details of a specimen or area being tested, since their size can be controlled by a potentiometer mechanically coupled to the search unit.

Thus, if the potentiometer is properly adjusted, the cross-sectional details of a test specimen with a length of many feet can be compressed and viewed on a 16-inch screen. Or, the cross-sectional details of a very small specimen or limited test area can be magnified so that the most minute flaws can be easily observed.

Ultrasonic test methods will probably never replace x-ray testing techniques, since gamma radiations can be used to locate flaws in many materials with non-uniform composition—for example, in extremely porous castings and plastic laminates which would cause ultrasonic testing devices to produce a confusing variety of echoes and visual signals. However, ultrasonic techniques do appear to represent the least expensive and most effective means yet devised for the location of internal flaws in materials with uniform compositions.

It is worth noting that, while intense sound waves can be destructive, energy impulses that won't penetrate the thinnest layer of air create nothing remotely comparable to a radiation hazard. In fact, ultrasounds of the types used for test purposes have an established therapeutical value. And, according to recent report from researchers at the Massachusetts Institute of Technology and the University of Minnesota, they may soon be widely used to supplement x-rays for the accurate diagnosis of many internal diseases, including cancer types, which could not heretofore be identified without surgery.

—Radio Electronics.



Ultrasonic equipment indicated crack in specimen and was sustained when specimen was cut. X-rays did not show flaw.

Scanning image. Long white line represents upper surface of material. Dots and lines beneath it indicate flaws.

BRITAIN GETS VHF SOUND

(Continued from Page 7)

England has an advantage in that the BBC is able to take the initiative by establishing a chain of stations with wide coverage without depending upon advertising revenue to recoup its expenses.

Thus the vicious circle of stations waiting for sets, and sets waiting for stations, is avoided.

In the USA, where radio stations are all operated under private enterprise, FM transmitters have not made very much headway, and do not represent a great proportion of broadcast services. It is possible that the huge expansion in TV has diverted much of the interest from them, and that they may be more successful in the future than in the past.

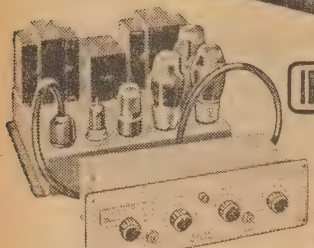
But it is quite a problem for a listener to contemplate a room full of radio gear including a standard broadcast set, an FM set and a TV set, as would be the case if he were to follow all trends.

The adoption of the VHF plan, therefore, may mean the eventual abandonment of the present broadcast band in Britain for standard entertainment for if such a network can cover the country adequately, it would be uneconomical to operate both bands.

This has always been a major factor when considering VHF—it may have to be all or nothing. In Australia, with so much invested in the broadcast band, and so much money to be spent in the next few years on TV, it is unlikely that much thought will be given to VHF broadcasting for some time to come.

But we may be sure that many will be watching the reaction in Britain to the new scheme, and absorbing any lessons which may be learned from it.

4 BIG NAMES NOW AT MAGRATHS



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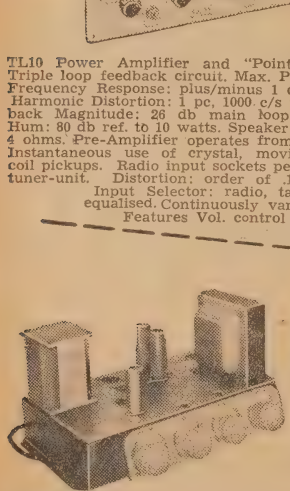

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Tone Control: the 2 RC tone control networks are placed directly after pickup, before grid input of Voltage Amplifier (EF86 type low noise, non-microphonic pentode incorporated). Bass Boost and Cut: approx. 10 db available at 30 cps. In Treble range approx. 10 db available at 10 kc. It has been found 10 db of bass boost insufficient for low volume correction below 100 cps. To obviate this, switch at rear of chassis increases bass boost for low level listening requirements. Frequency Response: virtually flat from 20 cps. to 80 kc. AC and DC power supply points for tuner. Output impedance: 2 or 8 ohms with either Rola 12OX or 12UX speakers. Separate bass and treble controls.

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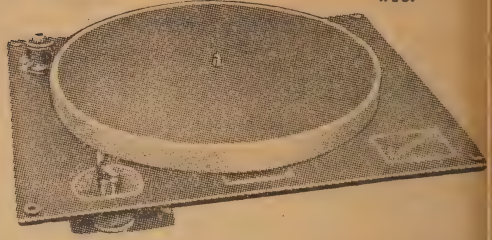

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The speed change is arranged mechanically and gives a 2 pc variation on all speeds, the synchronous motor running at constant speed at all settings. No breaking action is employed to obtain speed change.

It is suitable for playing standard transcription and microgroove recordings. Input voltages 220/250 v. AC 50 cycles, or as specified to order for 200/250 v. AC 60 cycles, or 110 v AC 50 or 60 cycles. Mounted on ¼in die-cast board 15¾in x 13¾in with 3¾in clearance distance below motorboard. Speed selector turret is fitted at left rear of motorboard. On-off switch at left front also releases pressure on rubber drive assembly. All motorboards are drilled to take Connoisseur Standard and Super Lightweight Pickups unless otherwise ordered. When used with these pickups mounted in position 3¼in clearance above motorboard is recommended.

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NEWS AND VIEWS OF THE MONTH

Saucer defence

MODERN air defence might need planes like flying saucers, members of the American Society of Mechanical Engineers believe.

The engineers, meeting recently in Baltimore (Maryland), said such projected three-dimensional saucers —to be called flying spheres — are purely hypothetical aircraft at present.

Modern air defence is concentrating on the need for planes which can do things attributed to flying saucers like taking off straight up, landing straight down and changing course radically in flight.

Brig.-Gen. Benjamin S. Kelsey, Deputy Director of Research and Development for the US Air Force, said fast, modern fighters spend too much time getting off the ground and not enough in the air.

★ ★ ★

Battle against smog

WHILE civilisation remains concentrated in big cities and industry fills the air with smoke and waste gases from engines, the problem of smog seems likely to be always with us.

In London it has several times in the past 12 months been bad enough to disorganise traffic and injure health.

Scientists, baffled in their efforts to trace the exact causes of smog, have now turned to an electric brain for help.

This was announced to engineers attending a meeting on air pollution symposium by Dr. Lauren Hitchcock, head of the Los Angeles Air Pollution Foundation.

Dr. Hitchcock said the machine may help fathom the mysterious mixture of smoke and fog which is rapidly becoming an international problem.

Results of an exhaustive study of Los Angeles' atmosphere during the recent four-month smog season are being recorded on punch cards by the machine.

General opinion among experts was that smog comes from car exhausts, industries and the thousands of backyard incinerators used in California.

But the smoke does not become smog until it has gone through mysterious chemical reactions in the air. Dr. Hitchcock said.

Dr. Frits Went, a plant physiologist, said smog damage to plants was alarmingly widespread.

It had been observed not only around Los Angeles, but in New York, London, Paris, Algiers, Copenhagen and in Brazil and Columbia.

Typical smog damage to plants is the stunting of growth and "silvering" of the underside of the leaves, he added.

★ ★ ★

TV in warships

THE uses of TV are by no means confined to entertainment. Already we have seen how industrial type TV may be used for education in medicine, and in communication where an instant moving picture is more valuable than a telegram or a picturegram.

Such TV services need not radiate a signal through a radio transmitter, but may be sent over special cables for limited distances.

Canadian naval technicians are testing television in a warship for possible use in wartime.

Officers at six key points in the ship, including the bridge, get an immediate television picture of the tactical situation.

This is shown by means of a camera in the operations room focused on a plotting chart.

The chart records movements of enemy aircraft, surface and undersea craft, as well as those of friendly ships.

The idea is to pass on visually tactical information now relayed by phone.

An official of a Cambridge TV factory said the Canadians had sent the warship to Larne near Belfast, to be fitted with TV.

All workers who took part in the job were sworn to secrecy.

★ ★ ★

Engines of the future

BRITAIN, the cradle of the modern jet engine, is not allowing grass to grow on plans for engines of the future.

More and more concentrated power is being sought by all the famous makers of engines, who realise that constant research and development are essential to keep abreast of modern requirements and competition.

Speeds of 2000 mph are likely for a new aircraft rocket engine.

Named The Screamer, the engine is being tested in a Gloucester Meteor near Coventry.

It has been designed as the answer to the high-speed jet bombers.

The makers, Armstrong-Siddeley, claim the engine will give speeds of 2000 mph at 100,000ft.

A company spokesman said:

"The Screamer is of the next generation of engines.

"It will power an aircraft on its

POPULAR SCIENCE QUIZ

Q. Is it likely that the present types of material used in aircraft constructions, such as aluminium will continue to be used for the higher speed aircraft being developed?

A. Present indications are that, for outer surfaces, they will be replaced by such metals as titanium and stainless steel. These metals combine excellent heat resistance properties with lightness and strength.

The ceramic group of materials also offers a possible solution for the lining of the jet tubes as the heat problem encountered here is similar to that in industrial furnaces.

Q. What is a siderite, a aerolite, a siderolite?

A. These are the three groups into which meteorites are classified.

A siderite is composed entirely of metal, mainly iron.

A aerolite is composed largely of stone.

A siderolite is a meteorite which is half metal and half stone.

Q. What means are being explored to increase the astronomers' viewing distance beyond the capabilities of the 200in Mt. Palomar telescope?

A. It is proposed to use a combination of electronics and a conventional optical telescope to build up on a photoelectric surface an electronic picture of the part of the heavens being viewed.

The output of this will then be applied to a cathode ray tube having a photographic plate in place of the usual viewing screen.

The increased sensitivity is obtained through the development of a photoelectric plate which is many times more sensitive than the best photographic emulsion type.

Q. What is the latest technique used in placing equipment on the site when drilling for oil at sea?

A. A new and unique solution to this problem has been devised by the Shell Oil Co. to enable them to drill for oil on their new lease in the Persian Gulf.

The drilling equipment is carried on a large steel frame which is towed to sea on two barges. When the location is reached, eight hydraulically operated legs are forced down to the sea bed raising the platform from the carrier barges.

The barges then return to port until the "movable steel island" is required to be moved to a new location.

The drilling platform is 140ft long and 90ft wide and when in position is raised some 40ft above sea level.

Because of the difficult weather conditions, accommodation has to be provided on the island for the relief drilling crew as well as stores, plant, refrigeration and air conditioning .

TWO NEW Fluxmaster models

These new versions of Australia's two most popular loudspeakers — Models 5C and 5F — now employ the Rola Fluxmaster principle.

Its introduction in these models has raised their already high efficiency yet reduced their cost to a point where, without question, they represent the best value for money in the 5" speaker group.

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own, or, used with a jet, it permits a fantastic rate of climb, immense ceiling and heights, and speeds far higher than those possible with jet turbines.

"The Screamer can operate from sea level to infinite height because its power increases as the altitude increases.

"The great advantage of rocket engines is that they are entirely independent of the atmosphere and maintain their thrust at extreme altitudes or even in outer space, where no other type of engine can operate."

All details of The Screamer are secret except that it is a liquid-propellent rocket motor designed for used in piloted aircraft.

It has been running for some time in ground tests.

It succeeds the Armstrong Sidderley Snarler, the first British pure rocket motor which will probably undergo test flights shortly.

★ ★ ★

Super x-ray plant

PROFESSOR S. H. ROBERTS said last month he believed Sydney should acquire a super voltage x-ray machine for cancer treatment as quickly as possible.

Professor Roberts is chairman of the State Cancer Council.

A super-voltage unit can project x-ray beams of 4-million volts.

Professor Roberts said it was essential Sydney should have a high voltage unit for treatment of cancer.

"We should get the equipment before the establishment of the proposed £750,000 cancer centre," he said.

"The State Government already has approved the purchase of the unit for the new centre.

"The Government has provided the money for the cancer centre, but building is slow.

"Years will pass before the centre is built.

"In my opinion we should be able to give high voltage x-ray treatment before the centre is built."

★ ★ ★

Safety belts for cars

THE human toll in road accidents is a problem all over the world, particularly in the USA where so much of private and industrial transport runs on motor tyres.

It is not likely to improve while cars continue to be produced on a wide scale with hundreds of horsepower available, and speeds of 100 mph and more are common.

Speed in itself need not be dangerous, but speed at the wrong time and place is a killer. A sudden stop at high speed may injure passengers even where there is no actual collision.

In America a motor company is now offering safety belts as factory equipment on cars for the first time.

Use of seat-belts in cars has been suggested as a safety measure for several years, but this is the first time a car company has offered them for sale.

The belts, similar to those used in passenger planes, will be sold either in sets of three for the front seat alone, or in sets of six for both seats.

The Chrysler Company said the belts will be available on all five models of their cars.

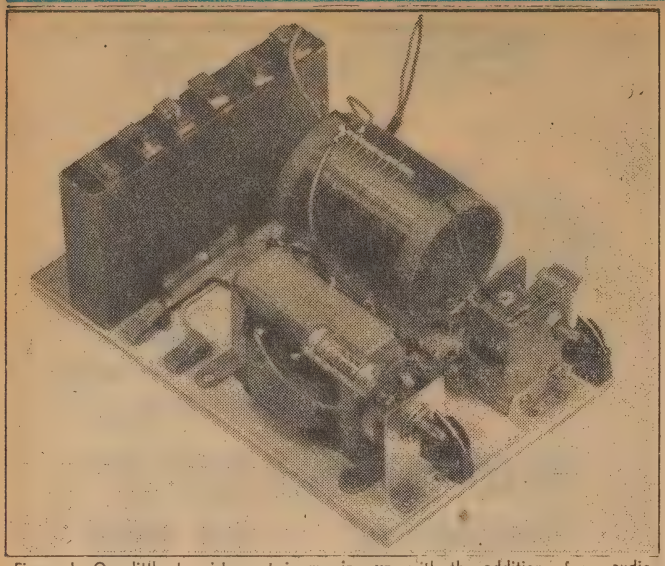

Figure 1: Our little transistor set is growing up, with the addition of an audio stage. The transistors are hopelessly dwarfed by the other components but our object at present is to learn their basic principles, not to achieve the ultimate in miniaturisation.

A 2-STAGE TRANSISTOR SET

Let's assume that you have, by this time, read last month's article and built up your first transistor set. This month we propose to go a step farther, adding an audio stage and taking in such additional problems as interstage coupling and operating bias.

by Neville Williams

TO students of valve theory, these subjects are quite elementary by reason of long usage. But we are not talking about valves now—we are talking about transistors and, as we have already seen, they are distinguished by having a very low input impedance and altogether different voltage and current requirements.

These factors necessitate a quite different approach, both in regard to circuit arrangements and component values.

At the same time, we have to learn something about the basic voltage, current and wattage ratings, which apply to transistors, just to any other electrical component. We have to learn something about operating conditions, so that whatever transistors we choose are used intelligently.

MUCH TO LEARN

It isn't hard to imagine that all this adds up to a rather considerable total and is far in excess of what can be covered properly in a single article. Just imagine how much space it would involve to set out, even on a "popular" level, all the things that we have come to know about valves as audio amplifiers.

Our aim in this article, therefore, is not to attempt a detailed study of transistor ratings and characteristics. We want only to cover the salient points, so that you will be aware of them, then go on to illustrate the use of transistors in audio amplifier service.

Let us begin, then, by pointing out that each type of transistor has its own maximum voltage, current and wattage ratings, which have to be observed if damage to the transistor is to be avoided. This "damage" may involve a serious change in characteristics or even complete disruption of the P-N junctions.

To be sure, we don't have to worry overmuch about ratings when applying just a few volts to a transistor detector, as we did last month. The position is quite different, however, when we attempt to use transistors in more ambitious circuits and obtain from them maximum gain and power output. Here we find a close parallel with our approach to simple little one-valve sets and receivers of the more elaborate kind, with audio stages attached.

An examination of overseas transistor charts reveals a very wide divergence in maximum ratings, which goes to emphasise the variations in transistor construction and, probably, some very different ideas on safety margins.

ACTUAL FIGURES

Maximum collector voltage ratings range from as low as 3 or 4 to as high as 200. Maximum collector current ranges from 5 to 40 odd milliamps and dissipation from 6 to 150 milliwatts. Variations of a similar magnitude are evident in emitter ratings.

One must therefore forget any notions that transistors are "accommodating little devices" which will accept any voltage which the user might wish to apply to them. In the ultimate, their ratings and applications have to be studied and applied with the same discrimination that is given to valve data.

Actually, of course, the foregoing remarks take in the whole range of transistors, currently listed, including many special-purpose types. Only a half-dozen or so varieties are likely to be in the hands of local enthusiasts at the moment and the gamut of operating conditions is limited accordingly.

In general, it will be noted that the point-contact types have higher all-round ratings. Junction types are inherently more efficient in terms of power consumption and more economical, but their ratings are lower.

WATCH ALL RATINGS

Another important point to watch is that the maximum ratings for any given transistor are all interdependent—just as they are with valves.

It may be permissible, for example, to apply 10 volts to a collector but NOT if the combination of this voltage with other circuit conditions allows more than the rated current to flow or more than the rated power to be dissipated.

Similarly, it is not sufficient to satisfy all requirements of the collector circuit, if some limiting condition at the emitter is exceeded.

More than this, we cannot say

at the moment. We haven't explained much about ratings—we have merely tried to emphasise that they exist and must be observed if proper service is to be obtained from any given transistor. Constructors must ultimately learn to interpret such ratings for themselves or be content to adhere rigidly to published circuits.

So much then for "static" ratings and operating conditions as measured by voltage and current meters. There is another aspect of the subject, however, which must be considered carefully in all transistor circuits. This has to do with peak (or transient) voltages and currents.

As we have already seen transistors rely for their operation on a rather delicate balance in their molecular structure. They are relatively low impedance devices also and the application of a brief surge voltage may well produce a current pulse through them of damaging proportions.

Even if the pulse does not ruin the transistor altogether, it may permanently change its characteristics.

SURGE PROTECTON

Such voltage and current pulses may be produced by the sudden introduction into a circuit of a charged or uncharged capacitor, by making or breaking a connection, by careless handling of battery leads and so on.

A certain amount of surge-protection can be built into transistor circuits but much anguish can be saved by observing one simple golden rule . . . DON'T FIDDLE WITH TRANSISTOR DEVICES WHEN THE SUPPLY VOLTAGES ARE CONNECTED.

We'll have a little more to say about this later, when talking about typical circuits.

Occasionally, you will find references in transistor articles which suggest that the collector voltage must always be removed before the emitter bias, under pain of burning out the transistor with excessive collector current.

Such statements conflict rather obviously with our explanation, last month, of transistor action, whereby collector current was said to be dependent largely on having a forward voltage present on the emitter. Removing the bias should cause the collector current to fall practically to zero—not rise to damaging proportions!

It doesn't take long to demonstrate with a meter and battery that the emitter voltage can indeed be removed quite safely, so that the heavily printed warnings appear rather out of step with observed conditions.

MORE RELIABLE

In point of fact such warnings appear to be based partly on misunderstanding and partly on experience with early type point-contact transistors, which were likely to oscillate violently or behave in rather unpredictable ways when exposed to temporary or "accidental" circuit conditions.

Modern transistors and junction types in particular appear to be much more consistent and less liable to behave in unpredictable ways.

BASIC TRANSISTOR CONNECTIONS

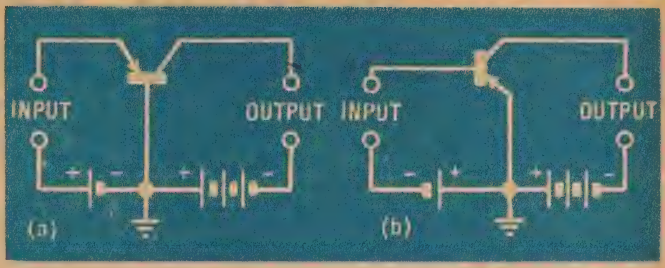

Figure 2: Illustrating the connections for (a) grounded base and (b) grounded emitter operation, assuming a P-N-P transistor. Grounded collector operation is also possible but of no immediate interest to us.

While we may therefore not require to be quite so particular about the order in which voltages are applied, we must still be very particular about protecting transistors from surge currents, as already mentioned.

Once again—don't fiddle with transistor circuits while the supply voltages are connected!

Then there is another point which must be appreciated, relating to the way transistors are wired into circuit. Here again it is interesting to draw a comparison—or in this case a contrast—with valve practice.

When using valves, it is conventional to have the cathode at earth or near-earth potential, feeding the input signal to the grid and taking the output from the plate. This practice avoids any serious problems with supplying the heater or filament power and also allows a high potential to be applied without difficulty to the plate.

At the same time, it is possible to operate valves in other circuit configurations. Audio enthusiasts will be familiar with "grounded plate" and cathode-follower circuits, while VHF fans will know something of "grounded grid" RF amplifiers.

While these and similar applications are quite important in their own way, they are sufficiently rare to be very much the exception. Valve application data and circuit design normally assumes "grounded cathode" operation.

The position with transistors is not nearly so clear. Because of the moderate voltages involved and the fact that there are no heater circuits to worry about, there is little to choose, as far as circuit complexity is concerned between grounding the base, the emitter or the collector.

GROUNDED BASE

At present grounded base operation is regarded as the "conventional" mode of connection but junction type transistors are very frequently found in grounded emitter and even grounded collector circuits. (Point-contact transistors, having a current gain greater than unity, are often unstable with grounded emitter operation.)

As with valve practice, these alternative configurations are used to achieve particular characteristics.

While we cannot afford to study the subject here in detail, it may be said in passing that grounded base operation gives low input impedance, high output impedance and maximium output power from a given transistor; grounded emitter gives a moderate input impedance, high output impedance, maximum voltage gain and moderate output power; grounded collector operation is closely parallel to cathode-follower operation in a valve, giving high input impedance and low output impedance.

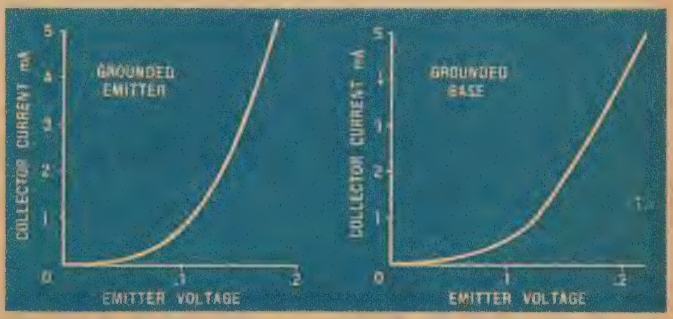

Figure 3: A couple of curves which we ran off showing the relationship between emitter voltage and collector current. These take no account of loads or impedance but they do indicate quite clearly the need for bias in audio stages.

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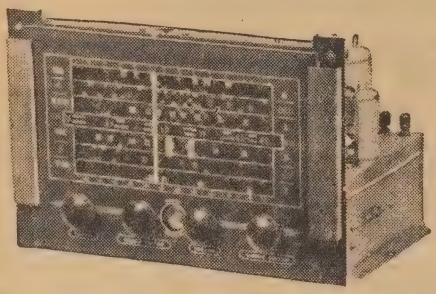

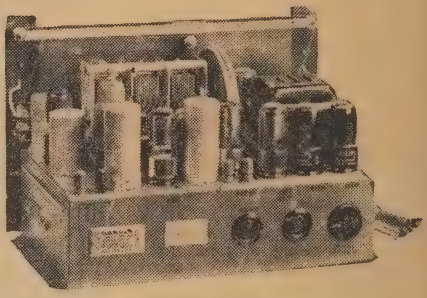

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TWO BASIC AMPLIFIER CIRCUITS

Figure 2a illustrates the grounded base mode of connection and the polarity of emitter and collector voltages, assuming a P-N-P type transistor. Figure 2b indicates the connections for grounded emitter operation, once again assuming a P-N-P transistor.

With an N-P-N transistor, the applied potentials would naturally be reversed.

This leads naturally into the question of emitter "bias", which seems to baffle so many who are taking their first look at the subject. Really, it is very simple and not one wit more difficult to understand than the grid bias for an ordinary valve.

TYPICAL CURVES

Just to illustrate the point—and also for our own edification—we took a perfectly ordinary P-N-P junction type transistor and applied minus 4.5 volts to its collector. We then applied a positive bias to the emitter and read off the collector current as the emitter voltage was increased.

This was done for both the grounded base and the grounded emitter connection and you can see the result in figure 3.

The curves take no account of circuit impedances and are therefore not a direct indication either of linearity or of gain. However, they do illustrate the input-output characteristics of a transistor reasonably well and indicate the higher gain which is available from the grounded emitter connection.

As we explained last month—and as the curves clearly indicate — the collector current in this case is very low when the emitter is at the same or a negative potential with respect to the base. However, as the emitter is made positive, the collector current rises sharply, reaching something like 5 milliamps with only 0.2 volts on the emitter.

This is just the thing for detector service. The emitter is operated without any initial "bias" but swung positive and negative by the incoming signal. Collector current flows during the positive swing but not during the negative swing; rectification therefore takes place and the "detected" signal is made audible in the phones.

However, where a transistor is to be used as an amplifier, this rectifying or "detecting" characteristic must be avoided at all costs. We must see to it that the collector draws a suitable amount of standing current, which is then varied in cyclic fashion by the incoming signal.

STANDING BIAS

How to do this must be fairly obvious. We must apply a small standing positive voltage on the emitter, sufficient to initiate a suitable value of collector current. The signal will then swing this collector current above and below the initial value at the signal frequency.

The position is closely analagous to the case of an ordinary valve, where the grid bias is adjusted to allow a convenient amount of plate current to flow. In the presence of a signal, the plate current then swings about this initial value.

The important difference, as we have already seen, is that the emitter is always biased in a forward direction, so that it also draws current, both from the bias supply and, of course, the signal source. This results in a comparatively low input impedance and necessitates "drive" from a low impedance source, rather like a conventional B-class audio stage.

With a point-contact or P-N-P junction type transistor, normal amplifier operation is with a negative voltage on the collector and the emitter biased positively with respect to base. With N-P-N transistors, the voltages are of opposite polarity.

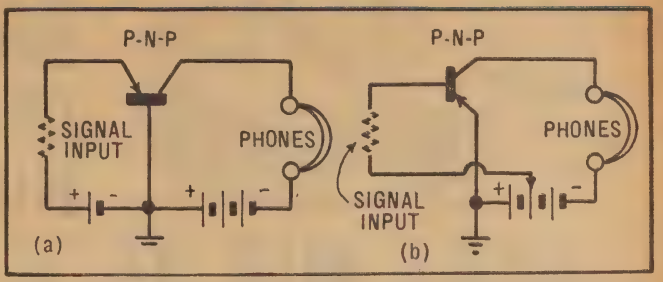


Figure 4: The basic amplifier circuits normally employed for audio work. The complete receivers shown in figures 5 and 6 use the grounded emitter arrangement as in (b) above

GENERAL STATEMENT

To put the statement in a general form to cover both cases, we say that the collector operates with a "reverse" voltage applied, while the emitter is "forward" biased.

One more thing and we are well on the way to resolving the so-called "difficulties" of emitter bias.

Though we have spoken thus far of bias as a forward (in most cases a positive) VOLTAGE, the effectiveness of the bias is really measured in terms of the forward CURRENT which it produces in the emitter circuit.

(You will remember from our discussion last month, that current in the emitter circuit initiates current in the collector circuit.)

Rather than specify bias voltage, discover emitter impedance and then work out emitter current by Ohm's law, it is much easier to specify current in the first instance. And for that very simple and very practical reason, you will generally find in transistor operating conditions statements about maximum and typical emitter forward current.

If you have need to measure the bias current, it can usually be done with nothing more elaborate than a simple milliammeter. As often as not, however, you will find yourself adjusting bias to give a suitable collector current—or just following in detail a published circuit!

How reminiscent of ordinary valve practice.

With this general theory behind us, we can now become a little more specific and elaborate somewhat on figure 2.

BASIC CIRCUITS

Figure 4a shows the basic circuit arrangement for a point contact or P-N-P junction transistor amplifier, with base connected to ground. A positive voltage is applied to the emitter return and a negative voltage to the collector.

Here an understanding of ratings, as already discussed, can be of immediate assistance. We may discover forthwith the voltage which can be applied safely to the collector for the particular type in which we are interested. The next step is to apply the correct bias to the emitter.

The thing we must NOT do at this stage is to connect the emitter return to a tapping on the bias battery to see what happens. It may happen with a rush!

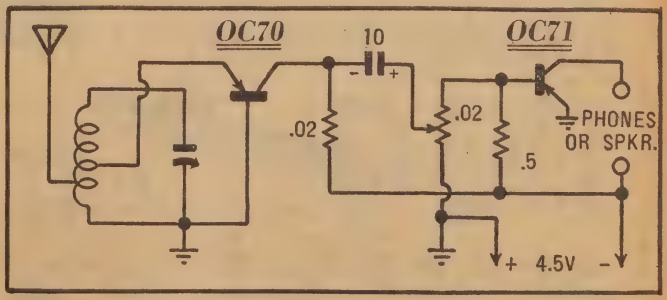
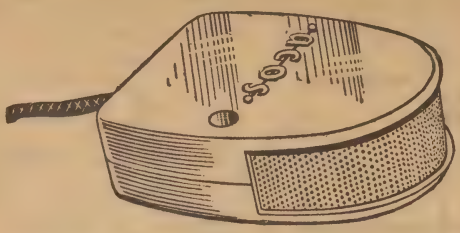


Figure 5: A complete 2-transistor set using resistance coupling between stages. Reasons for the various circuit values are given in the text.



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The wise experimenter will connect the emitter's normal return resistor to the centre of a low value potentiometer, then connect the potentiometer across the bias source with the tapping initially at the earthed end. The bias can then be applied gradually, while metering the collector current.

If you find that the full bias can be applied from a particular tapping on the bias battery, well and good. If not, you will have to make some other suitable arrangement, as illustrated in figures 5 and 6.

It is sometimes possible to use self-bias, with point-contact types in particular, by inserting a resistor in series with the base-earth lead, heavily bypassed to prevent instability. We may have more to say about this at a later date.

GROUNDED BASE

The grounded base arrangement is normally employed with point contact transistors or with junction types where power output is more significant than gain.

Figure 4b shows a grounded emitter circuit, which is commonly used with junction types, where high gain is required. The important difference is that both the base and the collector voltage are negative with respect to earth. (This is obviously necessary, if the earthed emitter is to be positive with respect to base.)

It does mean that the bias and collector supplies can be taken from the one battery through suitable circuitry. This must be done carefully, of course, to avoid the application of excessive bias and the promotion of excessive collector current, as already suggested.

A glance at figure 3 will demonstrate that anything above about 0.25 volt would be "excessive" bias for the junction transistor which was the subject of the curves.

And this is about as far as we can go, while still talking in general terms. The next step is to look at a couple of circuits which have been devised to suit two particular transistors, chosen mainly because they happen to be the cheapest types available at the time of writing. They also happen to be junction types, with very modest power requirements.

Readers wishing to use other type transistors will have to adapt the circuit as best they can and in the light of earlier discussion. There is a limit to the versatility one can build into a specific design; after all, we don't design valve circuits to accommodate every type in the catalogue!

TYPICAL CIRCUIT

Well, then, let's look at figure 5, which shows a 2-transistor set, with resistance coupling between stages.

The "front-end" is exactly the same as in the one-transistor set featured last month. The differences occur from the collector circuit onwards.

In place of the phones we have wired a 20,000 ohm resistor, which becomes the output load for the detector. Its value is not particularly critical, but there is no point in making it large in the hope of achieving high gain, because it is shunted in any case by the low input impedance of the next stage.

The precise input impedance to the second stage is likely to vary with individual transistors, but it can be reckoned as being about

TRANSFORMER COUPLED CIRCUIT

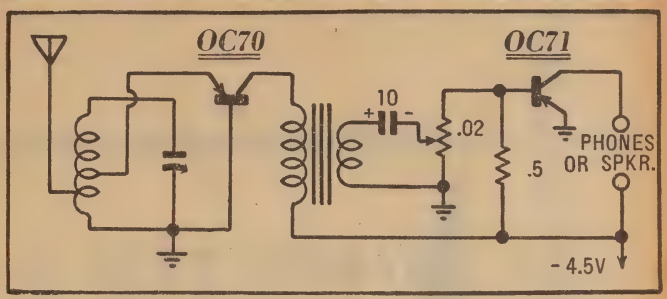


Figure 6: The circuit used in the experimental set pictured on the first page of this article. It uses transformer coupling between stages, with a step-down ratio between primary and secondary windings. An ordinary 3:1 or 5:1 audio transformer will do, connected back-to-front.

1000 ohms—a very different proposition to a valve amplifier!

With an impedance of this order, it is clearly not practical to use the "traditional" values of interstage coupling capacitance, say .01 to .05 mfd. For reasonable bass response, the capacitance must be pushed up to several microfarads, and, considering the low voltages involved, the obvious choice is one of the new midget low-voltage electrolytics.

Our circuit specifies a 10 mfd electro, which would normally be of the 40PV type, used to bypass valve cathode circuits.

The charge which such a capacitor can hold is a ready source for some of the damaging surges we mentioned earlier in the article. When metering transistor circuits, it is quite easy to see the charge and discharge effects of coupling capacitors reflected in the subsequent collector currents.

POLARITY

It is most important to see that such capacitors are connected into circuit in the correct polarity and it isn't a bad idea either to check them with an ohmmeter to see that they are not short-circuited.

Being electrolytics, you can expect different degrees of leakage according to the way the test leads are connected, but this is normal. The thing to watch for is an actual short-circuit.

From the coupling capacitor the signal passes to a gain control, which may appear redundant in such a small receiver. Actually, it is nothing of the kind because, on strong signals, and with a good aerial, the output from the detector will easily overload the second transistor.

The resistance value and connections to the potentiometer also require comment, because they are quite different from what we are accustomed to in valve circuits.

Since the input impedance to the OC71 is only about 1000 ohms, there is no point in trying to use with it a high value potentiometer. In fact, the result would only be a very abrupt control characteristic.

The suggested value of .02 megohm is quite satisfactory.

Normal transistor practice is to connect the signal input to the moving tap, taking the output for the next stage from the active side of the control. Purpose of this is to maintain a constant DC resistance between the input electrode and its bias source.

Since the emitter circuit draws current, irrespective of which electrode is grounded, any variation in the resistance of the emitter or base return circuits must lead to some variation in bias and, in consequence, to a variation in collector current.

Connecting the gain control as in our circuit avoids this difficulty, although it is perhaps not an ideal arrangement in other respects.

You will notice that we have connected the OC71 as a grounded emitter amplifier in the interests of high gain. A check between this and grounded base operation leaves no doubt on this score.

As we have already seen, this mode of operation involves the application of a negative bias current to the base circuit, which can most conveniently be derived from the negative collector supply. So much for the principle but what of the details?

Even assuming that we take both voltages from a C-bias battery, having a complete set of tappings, the smallest available potential of -1.5 volts is still for too high as a forward bias for the input circuit. Obviously some kind of a divider system is required to obtain a bias of the right order.

SWITCHING PROBLEMS

This might conceivably be arranged across the first cell of the supply battery, but we come up the immediate difficulty that a second pole would be involved in any "off-on" switch we might want to incorporate. There would be the further problem of obtaining the required -1.5 volts, if powering the set from an untapped torch battery.

To avoid these difficulties, we have shown a high resistance bleed connected directly from the collector supply to the base. This avoids the aforementioned difficulties and allows the set to be turned off with a simple switch in the negative battery lead.

We didn't bother to includue such a switch in our experimental set, but this is a mere detail.

The value suggested should be quite safe but, if you have a milliammeter on hand, its operation can be checked very simply.

Wire the set up as per the cir-

LOW MICROPHONY...

...low noise

6BK8/Z729—A-F PENTODE

Construction:

The 6BK8/Z729, 6.3V. 9-pin miniature A-F Pentode is the latest addition to the AWV Radiotron range. It is specifically designed for use in the early stages of high-gain audio amplifiers, such as those used with low-level microphones and pick-ups or for reproduction from tape. Flexible internal connector leads between each element and its base-pin, together with an extremely effective system of inter-electrode screening, have reduced to a minimum the effects of shock, vibration and hum pick-up.

Applications:

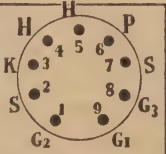
When used in a properly designed, resistance-coupled pentode circuit with a centre-tapped A.C. heater winding, the total hum voltage referred to the control grid will be less than 1.5 microvolts. The 6BK8/Z729 may also be used as a low-noise, resistance-coupled triode. This valve has the qualities of low microphony, low noise and low hum, essential for such applications. Full details of the 6BK8/Z729 will be supplied on application to the AWV Sales Technical Service, 47 York Street, Sydney.

Retail Price: 27/6

low microphony, low noise, low hum

6BK8/Z729—	TYPICAL RESISTANCE—COUPLED PENTODE OPERATION			
SUPPLY VOLTAGE	150	200	250	300
LOAD RESISTOR-megohms	0.22	0.22	0.22	0.47
SCREEN RESISTOR-megohms	0.56	0.68	0.82	2.0
CATHODE RESISTOR-ohms	3300	2400	2000	3600
FOLLOWING GRID RESISTOR-megohms	1.0	1.0	1.0	2.2
*VOLTAGE GAIN	150	175	200	310

*With an output voltage of 10 volts RMS



BASE DIAGRAM

RADIOTRONS

Manufactured in Australia by

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

cuit, but leave out the 0.5 meg. resistor. Clip your milliammeter in series with the "cold" phone or speaker lead and connect the set to the supply battery, making sure that you have the polarity correct.

With no forward bias on the input circuit, the collector current should be only a few mirco-amps. Now disconnect the battery and wire say at 1-meg resistor where we have shown the 0.5 meg. value. Switch on and check the current again, which will probably be less than half a millamp.

SUGGESTED FIGURES

Repeat the test with lower values of resistor, noting the progressive rise in collector current.

According to ratings, the collector can actually go as high as 10 milliamps, but there is no point in running anywhere near this figure The 0.5 meg. resistor specified in our article is aimed at promoting a collector current of about 1 milliamp, which seemed to yield more gain and output than any other level we could discover by a listening test.

Figure 6 shows an alternative circuit arrangement, which gives somewhat higher gain than the resistance coupled circuit. As will be obvious from the photograph, this was our preferred arrangement.

The transformer used in the original set was far more bulky than need be, being an ordinary class A audio transformer, intended for general replacement use in valve circuits. However, there are probably hundreds of old audio transformers lying around in experimenters' junk boxes and they can be pressed into service, at least for the time being.

Once again, because of the low input impedance to the second stage, best results are obtained when the transformer operates with a substantial step-down ratio. There is doubtless an optimum ratio for the application but, in practice, any audio type transformer having a ratio of 3:1 or higher appears to be satisfactory.

The larger winding, normally involving the "G" and "F" terminals, is wired into the detector collector circuit, while the normal "P" and "B" terminals feed the next stage.

In due course, we can expect specially designed miniature transformers to become available for transistor work. While these are produced by the thousand right now for hearing aids and other mass-produced devices, it generally takes quite a while for equivalent components to appear on the open market.

TRANSFORMERS OR NOT?

Even when they do, it will be a question of convenience and economy whether we settle for transformer coupling or for resistance coupling—with extra transistors to make up the gain! However, all this relates to the future.

You will note that we have coupled the transformer through a capacitance to the gain control. This has been done to preserve constant the base circuit impedance and to allow the bias to be applied in the same manner as per figure 5.

The same remarks apply, regarding the checking of bias and collector current, if you have the means to do it.

In both cases, we have specified an operating voltage of minus 4.5, which is in keeping with the maker's recommendations and ratings.

HIGHER VOLTAGES

Since the circuits were drawn, the normal operating voltage rating has been lifted to 5. Considering that the base is already slightly negative, there would seem to be no objection to running the set permanently from minus 6 volts.

In fact, we have run the original set quite a deal from minus 9 volts without any apparent ill effect. While this is close to the peak 10-volt rating for the particular transistors, it represents only a small fraction of the collector dissipation at the suggested current drain of 1 milliamp.

It's up to you!

The ability of the OC71 to produce output is rather amazing. Used with an ordinary permag. speaker and about a 10,000 ohm transformer, the output can be heard quite well in a quiet room. Even allowing for higher distortion than one might normally tolerate, it still sounds quite a lot for the mere 6 to 9 milliwatts of power that is being fed into the circuit.

On phones, of course, the volume is very loud indeed.

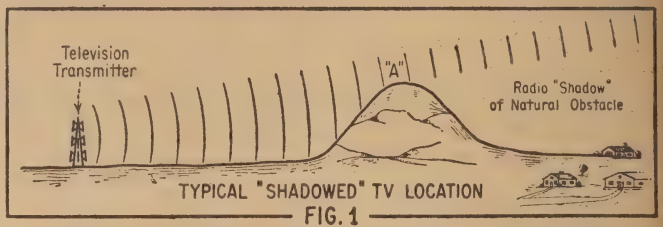
These remarks presume, of course, a reasonable location and a good aerial and earth. As we said last

(Continued on Page 111)

TELEVISION SHADOW RECEPTION

One of the most prevalent problems confronting the rural TV viewer and his service technician is that of providing reception at receiving sites well within the normal service range of one or more transmitters but "shadowed" by topographic details.

IN hilly or mountainous terrain, many communities, and, indeed, whole cities, are in the vexing position of having strong, steady television signals going by a few hundred feet overhead, but with little or no signal available to antennas of practical height in the valley. A typical situation of this kind is depicted in Fig. 1.

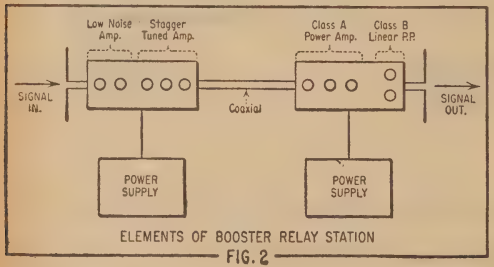


TYPICAL "SHADOWED" TV LOCATION
FIG. 1

The social and economic implications of this common situation are many and seem a high price to pay for a wrinkle on the surface of the earth formed long before anyone had television transmission in mind!

To the viewer, it means missing out on the educational and entertainment miracle of television. To the TV dealer and serviceman it means whole fields of potential set sales and servicing lying fallow. And, of course, to the television broadcaster and advertiser, it means reduced coverage.

There are several approaches which might be used in "illuminating' 'a television receiver or community situated as in Fig. 1. They include:



ELEMENTS OF BOOSTER RELAY STATION
FIG. 2

(a) A booster station located on the hill top at "A" and relaying the signal on the same frequency.

(b) A satellite station situated at "A" rebroadcasting the signal on another frequency, such as a UHF channel.

(c) A "passive relay" antenna at "A" receiving the television signal and re-radiating it into the valley.

(d) A community antenna located on the hill top with a transmission line distribution system feeding receivers in the valley.

In evaluating the applicability of these approaches to specific locations, there are many legal, economical, and technical factors to be considered. We will now examine some of these.

THE BOOSTER STATION

The operation of a relay transmitter modulated by the distant TV station involves considerable legal and technical complication. Legally it would require an official licence as well as an agreement with the television station whose programs were to be relayed. It also requires a source of electrical power at the relay station site as well as frequent or continuous attendance.

In general, the expense involved makes this the type of endeavor which must be financed on a commercial basis, rather than run as a community enterprise. Nevertheless, experimental booster stations of this kind have been authorised in the US by the FCC. (Ref. 1.)

The block diagram of a typical equipment lay-out required by a booster station is given in Fig. 2. A high gain receiving antenna oriented to receive the signal of the desired TV station, to the exclusion of any other on the same channel, feeds a low-noise RF amplifier.

This drives a linear power amplifier which builds the signal up to level required for re-radiation by a second antenna oriented to illuminate desired coverage area.

For single channel relaying the band width of the overall system must be at least six megacycles. The total system gain will depend, of course, upon the signal strength available from the master station. In "fringe" areas at least 100 decibels of overall gain must be provided if the coverage angle is large. Usually the power fed to the transmitting antenna need only be a few watts.

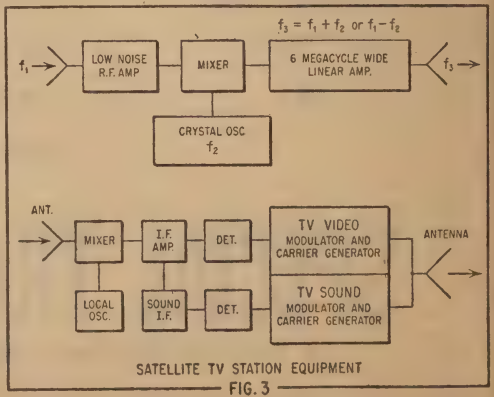
One of the technical difficulties encountered in the operation of a booster re-radiating on the same channel as the master station is that of feed-back. Enough isolation must be provided between the output and input to prevent such regeneration.

This is usually accomplished by utilising antennas with high front-to-back ratios placed back-to-back.

Additional isolation is also available by placing the receiving antenna and associated low-level pre-amplifier equipment a few hundred feet from the power amplifier and transmitting antenna. A high grade coaxial cable is used to interconnect the two.

One economic factor in favor of the booster approach is the fact that no expensive frequency control and sweep generator standards are required. Since the booster station is essentially a linear amplifier, all of the standards are established by the master station.

Thus, the cost of an installation of this type is much less than that of a small station capable of originating programs, but is still prohibitive for the isolated viewer or small community.



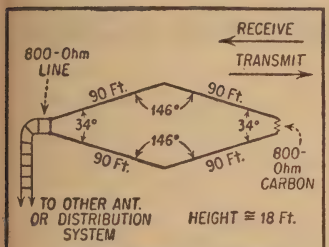
SATELLITE TV STATION EQUIPMENT
FIG. 3

Relaying the television signal on another channel frequency, such as a UHF channel, is even more complicated than same-channel relaying in many respects. In addition to requiring official authorisation and master station permission, considerably more equipment is needed.

SATELLITE STATIONS

Since the only manner in which the channel frequency can be changed is by heterodyning the master station carrier to a new frequency or by modulating a locally generated carrier on the new frequency with the video signal of the master station, facilities for maintaining the required frequency stability will be required in either case.

On the other hand, the problem



LARGE RHOMBIC ANTENNA FOR TV RELAYING
(Top View)
FIG. 5

of input-output isolation is eliminated in a relaying system of this kind, since the frequency transmitted is different from that received from the master station.

The satellite station can be arranged to select any one of several master station signals available and relay them on the allocated frequency.

Block diagrams of two possible equipments for satellite station relaying are shown in Fig. 3.

PASSIVE TV RELAYING

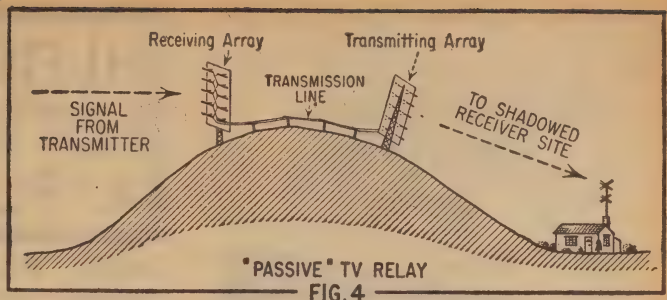
Another interesting possibility for television relaying in locations where a strong signal from the master station is available might be called "passive" relaying. The essentials of this scheme are illustrated in Fig. 4.

A high gain antenna situated on a high place within line-of-sight of both the transmitter and the shadowed receiver sites receives signal from the TV station and feeds it to another high-gain antenna oriented to re-radiate the signal into the valley.

This system has proven practical in several instances (Ref. 2). It has many advantages over the foregoing systems which put it within the reach of the single isolated receiving site or the small community.

Since this system is totally "passive", i.e., does not employ amplifying or transmitting equipment of any kind, official approval has not been required. For the same reason, no source of electrical power is required at the relaying site and a minimum of maintenance is necessary.

These are decided advantages since the sites which are suitable for relaying of this kind are usually quite inaccessible.



"PASSIVE" TV RELAY
FIG. 4

Another advantage offered by the passive antenna system is that of multi-channel operation. If several strong stations are located in the same direction, it will usually be possible to relay all of them simultaneously. In general, multi-channel installations will require the use of more elaborate antenna arrays, however.

If the site available for relaying is sufficiently large the rhombic antenna offers high gain and broad-banded operation while involving little expense. It can be constructed of wire, as contrasted to the more expensive aluminium tubing required in some other high gain designs.

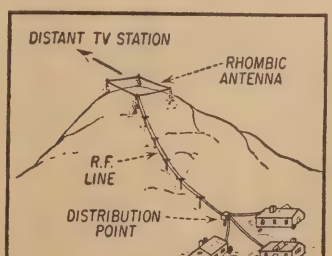
If the site is wooded, trees can usually be pressed into service to support the corners of the rhombics.

Because the radiation pattern of a large rhombic is rather sharp, care must be taken to properly align both the receiving and the transmitting antennas.

The major lobe of the rhombic is usually tilted a few degrees above the plane of the antenna. For this reason, it might be convenient to place the two antennas on opposite sides of the obstructing hill and interconnect them with a low-loss, high-impedance transmission line.

Fig. 5 shows the dimensions of a rhombic antenna design which would be suitable at some locations. Other design information can be found in references 3 and 4. In general, the gain of a rhombic increases with the number of wavelengths per leg.

Another antenna type which could be used is the "chicken-wire horn", illustrated in Fig. 6. This design provides all-channel operation and reasonably high gain, while requiring less space than the rhomic. Two



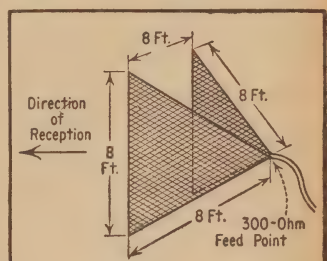
COMMUNITY ANTENNA SYSTEM
FIG. 7

such antennas could be used back-to-back at the crest of the hill or separated by some distance and connected with 300 ohm line.

Of course, the length of the line should be kept to a minimum since its losses detract from the gain provided by the antennas.

Other high gain TV antenna designs could be utilised for passive relaying. In instances where only single channel operation is desired, multi-element stacked Yagi designs, cut for the proper frequency, will provide good gain and directivity in small space. Antennas of the "billboard" type should also be useful.

In the choice of the transmitting antenna, attention must be given to the angle of radiation. If the re-



"CHICKEN-WIRE HORN" ANTENNA
FIG. 6

ceivers are spread out over considerable area close to the re-radiating antenna, the pattern of this antenna must be wide enough to illuminate all of them.

Since the object of the relaying system is to provide as much total system gain as possible, the antennas at the receiving sites must also be high gain designs of the variety usually employed in fringe areas. They, in turn, must be accurately oriented on the hill-top relaying antenna.

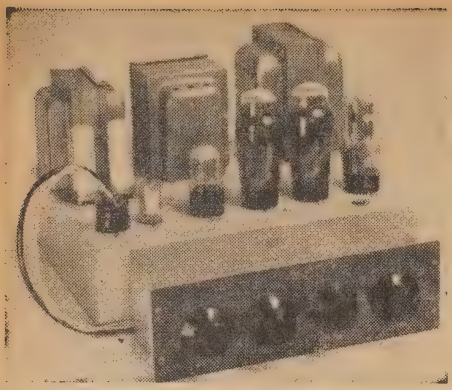
COMMUNITY ANTENNA SYSTEMS

At locations where the receiving sites are only a few hundred yards from an elevated place where relatively strong television signals can be received, the community antenna scheme has been used successfully.

As illustrated in Fig. 7, this system utilises a high gain antenna on a high place and a long, low loss transmission line distribution system to "pipe" the signal to one or more recievers.

Technically, the problems associated with the community antenna approach are very similar to those

(Continued on Page 112)



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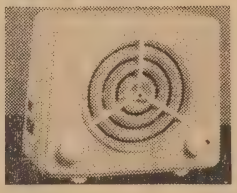
- Amplifier No. 5 (5 Valves 10 Watts)
- Amplifier No. 6. (5 Valves 8 Watts)
- Amplifier No. 7 (5 Valves 10 Watts)
- Crystal Pick-up Amplifier
- Vibrator Amplifier (6 Volt)
- Standard Amplifier Nos. 1 and 2 and Tuner
- Tuner No. 1 (2 Valve D/W & B/C)
- Whistle Filter
- Tuner No. 2 (3 Valve T.R.F. with Filter)
- Wide-Range Tuner (1900 K.C. with Filter)
- Wide-Range Tuner No. 2 (455 K.C.)
- Ultra-Linear Amplifier
- Control Unit No. 1 (1 Valve with Vol. Cont.)
- Control Unit No. 2 (De Luxe Model)
- Control Unit No. 3 (Special Type)
- Control Unit No. 4
- Control Unit No. 5
- Control Unit No. 6 (For low output pickups)

KIT-SETS



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Dears Sirs,

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Name .....

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Here's your answer, Tom!

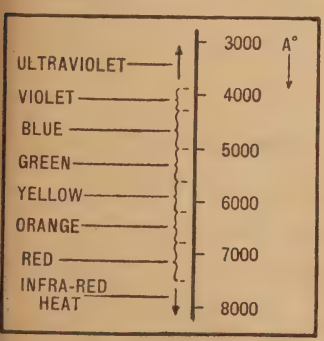
We "radio blokes" often tend to lose sight of the fact that the frequency range we use for radio transmission is but a small part of a physical phenomenon which comes under the general heading of "radiation". Well, Tom didn't lose any time to drive home this fact in a letter of four pages, and closely written at that.

TO be more particular, he is very interested in the relationship between radio, heat, light and other kinds of waves.

Let's have it, Tom!

In the March issue there was a table showing the frequencies and wavelengths of different kinds of radiation. No matter how hard I looked, though, I could not see any reference to heat rays. And yet my textbook says, that radiation occurs, in the form of wave energy, when heat is transferred along the ether. Where do heat rays come in?

You should have looked a little



harder, Tom, because heat rays really appear on the table, although not spelled H-E-A-T. Have you heard the saying, "A rose by any other name . . . .?"

Long before the discovery of either radio or x-rays, it was known that "white" light could be split up into different colors by allowing a narrow beam of light to fall on a glass prism.

Then somebody got the idea of measuring the temperature of these different colors with a very sensitive thermometer. In the process, they found that the thermometer showed a pronounced rise in temperature when exposed to rays outside the spectrum, just beyond the red end.

It was realised that this heat radiation must be part of, or related to, the visible light, and it was therefore called infra-red radiation. The word 'infra" in Latin means beyond.

So you see, Tom, heat radiation and infra-red radiation are really one and the same thing. It cannot be said, however, that the scent accompanying heat radiation is always as pleasant to our olfactory organ as that of roses!

And so to the next question:—

Looking at the spectrum of light you can see seven colors. How is it then that you can see a piece of metal become red, orange and yellow, when it is heated to a high temperature, but then turn white, instead of turning green, blue, indigo and ultimately violet, as you would expect?

Whoever has heard of only seven colors in the spectrum? You ask an artist, or, still better, a dress designer, what colors they can see in it—and they're likely to start reciting all kinds of fancy names. What's more, they'll do so with a good deal of justification.

You see, Tom, light is a form of electromagnetic radiation, similar to radio waves. As such, it occupies a certain band of frequencies in the spectrum, as shown in the diagram you were referring to in your first question. This band centres around 10 to the 15th c/s.

Each individual frequency within this band represents a color slightly different from neighboring frequencies and there is therefore an infinite variety of shades in the visible spectrum.

If the spectrum of white light is examined closely, what looks like a single color from the distance will reveal itself as a progression of shades of that color, gradually merging into what we regard as the next color.

When a solid is heated, it will first of all start to emit infra-red or heat rays. Then, as the temperature rises, red light appears, then orange and yellow. Together with these colors, it will later begin to emit green, blue and violet light, if the temperature is raised sufficiently high.

Since all these colors are emitted at the same time, they mix to give the impression of white light. If this white light is examined in the spectroscope (an instrument used to examine the color content of light), the colors are seen separately.

They are all there, only you have to look for them, Tom!

Black surfaces absorb all light that falls on them, and white surfaces reflect it. If light is a form of energy, what happens to the absorbed light? It cannot just disappear, can it?

No, Tom, it does not disappear. But it often gets away unseen—in disguise as it were—as a different form of energy.

Absorbed light energy has several ways of getting away from the absorbing body. It may escape as heat, kinetic, chemical or electrical energy, or it can even be re-radiated.

The temperature rise of a body when exposed to light is usually very small. It is, nevertheless, a measurable quantity and, in most substances, the absorbed energy is dissipated in this way.

There are some materials, however, which, by reason of their structure, dissipate light energy in a different form. Selenium and silicon are capable of converting it into electrical energy and "batteries" have been made (admittedly of very small capacity), which provide electrical power in this way.

A very ingenious little gadget, which used to be a stock item in school laboratories years ago, illustrated how light could be converted into kinetic or mechanical energy. Its name eludes us, but it consisted of an evacuated glass container, which held a tiny cross suspended at its centre on a needle bearing.

On each arm there was suspended a thin metal foil, one side blackened, the other polished to a mirror finish.

If this little gadget was illuminated from one side by a strong beam of light, the energy absorbed by the

blackened surface of the metal foil was sufficient to set the cross into motion.

Its speed could be regulated by dimming or brightening the light source.

This indicates that the kinetic energy is more or less proportional to the amount of light absorbed.

Another well-known example of light-energy dissipation is the photographic process, in which the light

NEW

NEW

MAGNETON TAPE FS.

TECHNICAL DATA

SENSITIVITY: The Agfa Magneton Tape FS for tape speeds of 19 and 9.5 cm/sec. ($7\frac{1}{2}$in and $3\frac{1}{2}$in/sec) has a sensitivity of plus 14 plus/minus 1 db for 1 kc/s, measured at 76.2 cm/sec, optimum premagnetization and related to the standard broadcasting tape (plus/minus 0 db).

FREQUENCY RESPONSE: The Agfa Magneton Tape FS has a frequency response of at least plus 5 db.

DISTORTION FACTOR: The distortion factor is lower than 0.5 per cent, measured as proportion of the 3rd harmonic (3 kc/s) of 1 kc/s. Thus the low distortion factor of the "FS" Tape ensures a particularly good and undistorted reproduction.

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separates silver and chlorine from the silver chloride contained in photographic emulsion. Here chemical energy is produced.

We haven't mentioned phosphorescence yet. Certain compounds, called phosphors, have the unique ability actually to store light energy, which is slowly released, after the primary light source has been removed.

Light is re-radiated from such compounds, although often in a different color. In other words, this means on a different wavelength and frequency.

Such re-radiation can only occur at a frequency lower than that of the primary radiation.

As we look along the electromagnetic spectrum, we can see, that ultra-violet and x-ray radiation has a still shorter wavelength and a higher frequency than visible light. Using such phosphorescent or fluorescent materials, we can convert the energy content of such radiation into visible light.

Almost everybody is familiar with the x-ray fluoroscope and fluorescent lighting. The former dissipates energy received from x-rays, while the latter converts ultra-violet radiation from the ionised mercury vapor inside the tube into visible light.

Here again we have re-radiation at a lower frequency.

In the case of phosphorescence the light is stored before being dissipated, while in the case of fluorescence, the absorbed radiation is re-radiated immediately.

By the time Tom has finished reading this page, he should be able to pass a Physics exam!

Oh, no! No! another question?

Yes, it is, and a curly one, too!

Why are some bodies transparent and others not? If a body is transparent for light, is it also transparent as far as other electromagnetic radiation is concerned? What is color? Has that got anything to do with it?

All this ties in very neatly with what we have said previously, Tom. There certainly is a definite connection between transparency and color.

It all has to do with the wavelength of electromagnetic radiation, in the form of light, or any other form.

Transparency and color depend on the atomic structure of the body in question. We must realise that there is far more vacant space in any body, than there is actual solid matter. The atoms or molecules are separated from each other, sometimes by a distance many times the diameter of the atoms or molecules concerned.

If the spacing of the particles is larger than the wavelength of the radiation, then that particular material is transparent to that or any shorter wavelength.

THICKNESS

A very good example for this is the heat-absorbing glass, as used in projectors. The molecular structure of this glass is such, that visible light will pass through it with very little loss.

But heat, or infra-red waves, on account of their larger wavelength, are either reflected from it, or absorbed. This glass still gives a strong light beam from a projection lamp, but protects the film from much of the heat.

Wood, or plastics, are not transparent as far as light is concerned, but x-rays, which are of a shorter wavelength, will pass through them unhindered. The same applies for the human body. This makes it possible to examine internal organs of the body with x-rays.

Yet the source of the rays, the tube, is usually hidden behind a plywood or plastic panel!

Of course, the thickness of materials also affects their transparency. Metal vapors, condensed on a sheet of glass, will form an extremely thin layer of metal, which is partly or wholly transparent for visible light.

COLORED OBJECTS

On the other hand, metal atoms or molecules are heavily packed by comparison, and the distance between them is small. Usually, the higher the specific weight, the better are the radiation absorbing qualities of metals. That is why doctors, who use x-rays a lot, have to wear lead padded gloves and aprons, to protect them from the effects of radiation.

What happens then, if the gap between the molecules is smaller than the wavelength of radiation? Well, Tom, that depends on the relative angle between the surface and the direction of radiation.

To understand this, we have to consider a surface area not bigger in diameter than two or three times the wavelength in question. If there is a relatively large angle between the surface, and the direction of radiation, most of it will be absorbed, but if the angle is small, most of the radiation will be reflected.

A rough surface may still reflect a large amount radiation, even though the angle of incidence is high in relation to the whole of the surface. This happens, because the projections from the surface are still big enough to reflect radiation of relatively small wavelength.

In the case of colored objects, the configuration of molecules is such that some wavelengths of light are absorbed, while others are reflected. Other substances, say colored glass, will absorb certain wavelengths, and will permit others to pass.

REFLECTIONS

A striking example of the effect of atomic configuration is given in three substances, coal, graphite and diamond. All of them consist of more or less pure carbon, and yet their behavior toward light is entirely different.

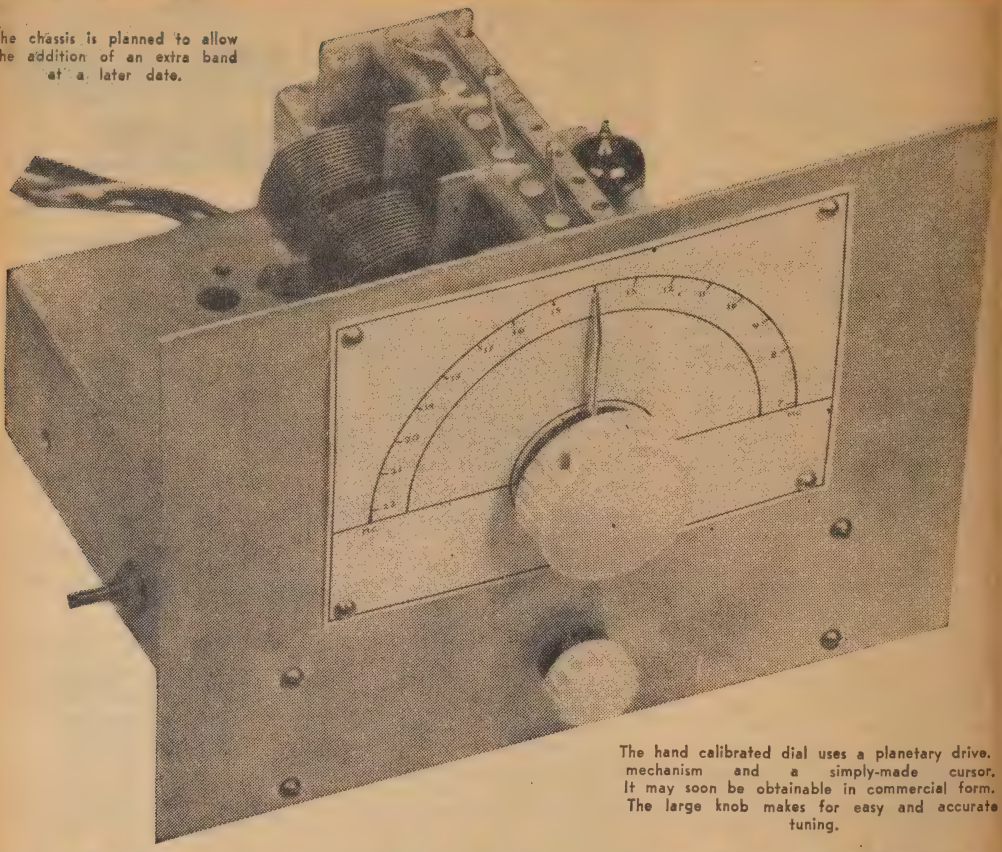
Coal has a shiny black surface, which does reflect light to a certain extent. The carbon atoms in it are rather tightly packed, but their arrangement is irregular.

Graphite is an almost perfect black, because it does not reflect any light at all. The atoms are very tightly packed, six of them on the corner of a regular hexagon making up a molecule. In subsequent layers these hexagons are offset against each other, making the distance between individual atoms very small.

Diamonds also consist of carbon, but the atoms are arranged in a different way again, permitting light to pass.

Just because we have been talking a lot about light, don't get away with

(Continued on Page 112)



The chassis is planned to allow the addition of an extra band at a later date.

The hand calibrated dial uses a planetary drive mechanism and a simply-made cursor. It may soon be obtainable in commercial form. The large knob makes for easy and accurate tuning.

A SINGLE BAND CONVERTER

This addition of this new short-wave converter can turn a quite-ordinary broadcast receiver into a high-performance double-change superhet. It will allow short-wave stations to be logged with power and clarity far ahead of an ordinary dual-wave receiver. The following article tells you how it works and explains how to build it.

by L. Varady

A NUMBER of years has elapsed since a circuit for a short-wave converter has appeared on these pages. Judging by the requests from our readers it is time we published another one, taking advantage of the improved performance at high frequencies of miniature valves.

The increase in popularity of short-wave listening is no doubt partly due to the large influx of people from the Continent, who, naturally enough, like to keep in touch with events at home.

Another reason is, that since the war, a number of overseas short-wave stations have commenced special programs for Australian listeners: With the aid of high-powered transmitters and directional aerials, receiving conditions in Australia have been vastly improved.

Improvements at the transmitting end, however, do not necessarily mean improvements at the receiver. More than ever the wavebands suitable for long-distance broadcasting are congested, with new stations appearing almost every day.

Special "communications" receivers can be made, and indeed are made, to overcome the problems arising from this state of affairs. The catch is that the average person, who looks to the short-wave bands for news and entertainment only, is not likely to invest his money in such a receiver, which would be very costly and sometimes difficult to obtain.

On the other hand, the majority of dual-wave receivers on the market today must make a compromise between acceptable results on short-wave and broadcast bands. In order to achieve reasonable selectivity combined with bandwidth on the broadcast band, an intermediate frequency of around 455 Kc is selected.

Then again, an audio amplifier stage is generally preferred, for added sensitivity, instead of an RF

stage, particularly if the receiver is called upon to provide entertainment from records.

With only one tuned circuit ahead of the converter, adequate selectivity becomes a real problem. Image interference is likely to occur, because the offending signal is only 910 Kc (twice the intermediate frequency) away. The one tuned circuit may not be good enough to eliminate the interfering signal completely.

Clearly then, there is a case for a small, inexpensive device which will enable the would-be short-wave listener to cope with such problems.

Such a device is the short-wave converter, which we propose to describe in this article.

Not only will this converter give better performance than the average dual-wave set, but it will also enable the owner of a broadcast receiver to enjoy the additional entertainment available on the short-wave bands.

A short-wave converter in its simplest form consists of a converter valve, and associated coils, tuned to receive one of the short-wave bands. Instead of providing the conventional intermediate frequency of 455 Kc, this valve supplies a frequency somewhere within the tuning range of the broadcast receiver to which it is attached. The actual figure used is about 1600 Kc.

DOUBLE SUPERHET

The whole setup then becomes a double superheterodyne short-wave receiver with considerable gain and good overall selectivity.

No power supply is required, as the small amount of power for the operation of the converter can usually be taken from the main set.

The present design is somewhat more elaborate, incorporating an RF stage ahead of the first converter. The extra gain can well be used, and better selectivity is obtained by using an additional tuned circuit.

We have not attempted to use unfamiliar circuits but have kept the design more or less on conventional lines. The provision of AVC was considered, but rejected because it would have involved too many modifications to the receiver proper.

In practice, this has not led to any difficulties, there being no sign of overloading in the converter, even with very strong signals and using a very large aerial system.

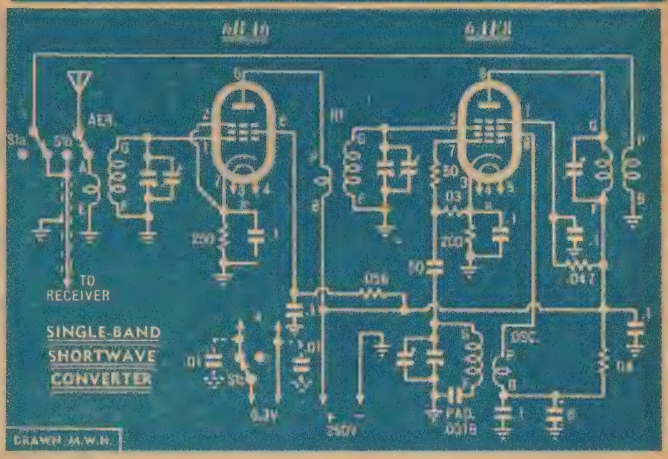
So we have then an RF stage using a 6BA6 valve. To keep the overall current drain low, and to avoid overload on strong signals, this valve operates in a slightly overbiased condition. With minus 2 volts bias it draws about 10 Ma. Increasing the bias to about 2.5 V reduces this to about 7 Ma, a valuable saving, if the receiver power supply is not too generously proportioned.

DECOUPLING

Each of the screens has its own separate supply network in the interests of stability. The resistors specified should suit the average case but it would be quite in order to increase or even decrease the values, should the necessity arise. The plate voltage is not at all critical but the screen and oscillator anode voltages should be about 85 volts.

As a frequency changer we have used the 6AE8, although with changer

THE SW CONVERTER CIRCUIT



The circuit is no more complicated than a normal tuner arrangement.

socket connections a 6AN7 would be suitable without any alteration to circuit values. We may mention here that the English type X79 is an exact equivalent of the 6AE8. The different numbering has often caused confusion in the past.

The oscillator plate is fed through its own decoupling network, comprising a .04 meg resistor, and 8mfd electrolytic and a .1 mfd paper tubular RF bypass. The resistance value is again given for 250 V HT, and it may be necessary to adjust this according to the HT available, to give the required 85 volts.

Oscillator squegging is prevented by the low values for grid capacitor and resistor, and the 50 ohm stopper

As we have mentioned previously, image interference could be experienced at intermediate frequency of 455 KC. In our case the problem does not arise, because the converter operates on an IF of about 1600 KC, which places the image 3.2 Mc from the received signal frequency. This is sufficient to ensure very good image rejection, which is so often experienced with standard dual waves.

A miniature broadcast aerial coil serves as output transformer, with the grid winding connected in the converter plate circuit. The original primary provides the coupling to the aerial input of the receiver proper, through a length of coaxial or shielded microphone cable.

This IF transformer is tuned to resonance by a 5 to 50 pf trimmer. Alternatively a 50 pf mica capacitor would do the job, using the iron core of the coil for tuning. However, for constructional reasons the trimmer is more convenient.

B/C RECEPTION

To avoid having to disconnect everything before the set can be used for broadcast reception, a two-position 3-pole switch is incorporated in the circuit, enabling the user to switch the aerial either to the input of the converter, at the same time connecting the output to the receiver input, or straight to the aerial input of the receiving proper.

In the aerial to converter position the third set of contacts connects the filaments of the power supply, putting the converter into operation. The high tension is connected all the time.

Should the converter show any signs of instability, it may be wise to bypass one or both the filament leads to earth with .01 capacitors, as shown in the circuit. This may

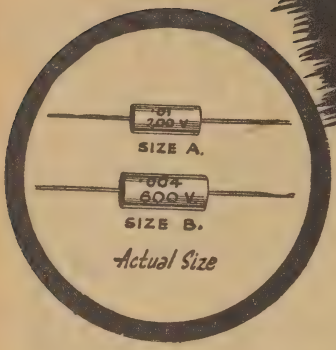
PARTS LIST

1 chassis 6 x 6 x 2 in.
1 panel 6 x 8 in.
1 three-gang tuning capacitor, min. AWA or similar.
2 valves, 6BA6, 6AE8.
1 min. plantary drive (Jabel)
1 switch, 2-pos. 3-pole, Oak type.
1 set of s/w coils, aerial, RF, oscillator, with iron core, unshielded, or 3/4in coil formers 16t.p.i., with adjustable slugs.
1 min. B/C aerial coil.
4 trimmers, 5-50 pf, flat chassis mounting.
2 valve sockets, 1 9-pin, 1 7-pin min.
2 spring terminals.

Capacitors:
3 .1 mfd 400 VW, 2 .1 mfd 200VW, 1 8 mfd 350 VW electrolytic, 1 50pf mica, 1 .0015 mica padder.

Resistors;
1 .04meg, 1W, 1 33,000 ohm 1/2W, 1 250 ohm 1W, 1 200 ohm 1W, 1 50 ohm 1/2W. 1 .047meg 1W, 1 .056meg 1W.

Sundries:
Screws, nuts, solder, solder lugs, tinned copper wire, hookup wire, coax, or microphone cable, 4-lug tagstrip, spaghetti, 2 knobs, scrap aluminium, cardboard for dial.



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MICROCAP TYPE W99

PERFORMANCE DATA

MECHANCIAL STRENGTH:

In the ultra-miniature W99 the wire pigtail leads are soldered directly to the capacitor unit in a manner that renders them free from intermittent contact and the strength of the joint exeeds the tensile strength of the lead.

INSULATION RESISTANCE:

Not less than 20,000 megohms for all values at working voltage at 20 deg C.

POWER FACTOR:

Better than 1% at 1000 c/s at 20 reg C.

SELF INDUCTANCE:

That of a solid piece of metal of the same dimensions as the capacitor unit, less moulding, and the selected length of lead out wire.

TEMPERATURE RANGE:

— 40 to + 71 deg C.
(— 40 to 160 deg F).

SELF-HEALING:

This very valuable feature enables the capacitor to sustain accidental over-voltage, and provides an additional safety factor.

TEST VOLTAGE:

150% of the working voltage for a period not exceeding 30 seconds at 15 — 20 deg C. Because of the self-healing feature a higher test voltage is neither desirable nor necessary.

CAPACITANCE TOLERANCE:

Standard — or + 20%; capacitances below 5 pf, — or + 1 pf. Closer tolerances of — or + 10% or — or + 5% are available for capacitances exceeding .0005 uF at additional cost.

Cap		Size	Cap		Size
200 Volts D.C. Wkg.			600 Volts D.C. Wkg.		
.004	uF	A	50	pF	A
.005	"	A	100	"	A
.01	"	A	200	"	A
.02	"	B	250	"	A
.03	"	B	300	"	A
.04	"	B	500	"	A
400 Volts D.C. Wkg.			.001	uF	A
.001	uF	A	.002	"	B
.002	"	A	.003	"	B
.003	"	A	.004	"	B
.005	"	B			
.01	"	B			

Size A 7/16in long x 3/16in diam.
Size B 9/16in long x ¼in diam.

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476 Latrobe Street, Melbourne.

)e particularly important, if it will)e used with more than one re-:eiver. One side of the filament :upply is usually earthed in the 'eceiver, so that earthing the leads n the converter may easily cause ı short circuit.

POWER SUPPLY

Almost any receiver would be ıble to supply the converter unit with power, apart from the small-est mantel sets. Power require-ments are 250 V HT, at 15 Ma, and 6.3 V at .6 A. The power could either be taken from a four-pin socket mounted on the receiver, or if you do not wish to interfere with the "innards", through an adaptor plug from the output valve socket.

It is possible to pick up the filament voltage from the heater pins and the high tension from the screen pin of the output valve this way. The earth connection would have to be made to some suitable position on the chassis near the output valve socket.

This is only possible, however, if there is sufficient room above the valve to allow the plug to fit.

That is about as much as we need to consider regarding the circuit, so we can now turn our attention toward the constructional details.

A chassis 6 x 6 x 2in conveniently accommodates all the components, with room to spare, and a panel 6 x 8in, takes care of the dial and changeover switch. Both these can be made easily from 18 g. sheet aluminium.

Actually an even smaller chassis would have done the job, but we intend to enlarge the unit later on to cover the 40-80 meter band. The larger chassis allows sufficient room for another set of coils and a change-over switch. This also explains the unused holes visible on the chassis.

Blueprints will be made available to the chassis manufacturers, so that you will be able to purchase the chassis ready made, if you wish to.

EARTHING

In the construction we must not lose sight of the fact that the unit has considerable gain, and an unsuitable layout might make it unstable. The earthing in particular needs careful attention.

To obtain best results, it is important to provide short return paths in all tuned circuits. We have overcome this problem by a network of busbars for the earthing, instead of relying on the chassis. It would be advisable to put the busbars into place before proceeding with the construction.

Solder lugs under the earth terminal, the rear gang mounting screws, the inside screw of the 6BA6 socket, and the front and rear corners of the chassis provide anchor points for the busbars. The front gang wiper is returned to a point on the busbar near the RF coil, while the rear one connects into the earthing system near the oscillator trimmer. The oscillator padder .0015 mfd also returns to this point.

As you will notice, trimmers are mounted in such a way that they can be adjusted from above the chassis. They occupy a position just above the respective coils.

There are only two main components mounted on top of the chassis, the gang and the IF coupling transformer, besides the aerial and earth terminals. Some form of reduction drive will be necessary for the gang to make tuning easier, and we have found a planetary drive released recently by Watkin Wynne very useful for the purpose.

This particular drive also solved the dial problem, because it is quite easy to attach a pointer to it. The dial scale can be easily made from a piece of white cardboard, with the frequency markings drawn in black ink.

The pointer is best made from a piece of scrap aluminium about 3-16in wide, bent into a loop at the bottom end. This loop is tightened on the slow moving nipple of the drive with a small screw such as an 8BA.

We understand that the same manufacturer is planning to market a complete dial kit, using the same planetary drive but including a dial card, pointer and cover plate. This should ideally suit the converter.

With these items secured in place, the wiring may be proceeded with.

The valve sockets occupy the right hand side of the chasis, the RF valve being nearest to the front panel. Orientation on both sockets is with the gap pointing toward the front left hand corner.

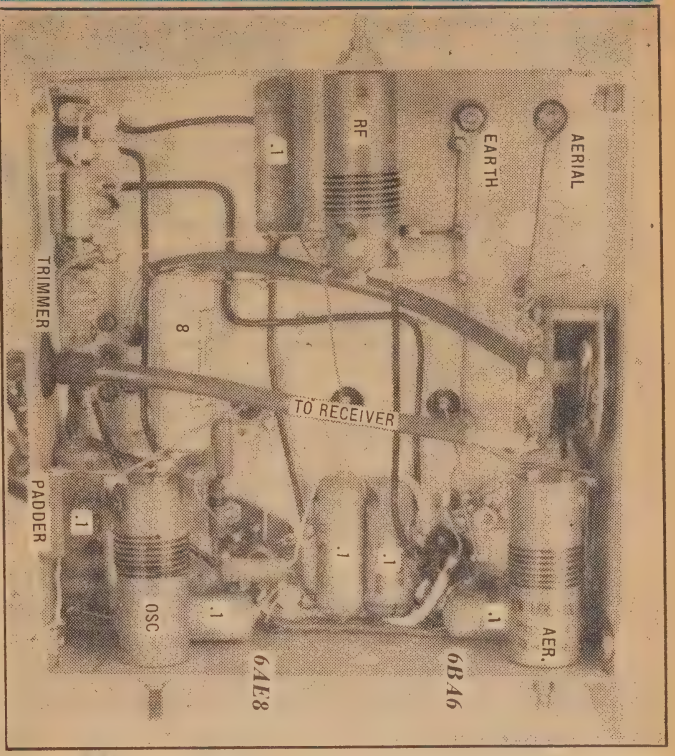
One side of the filament supply is taken straight to the pins, the other side is interrupted in the changeover switch as shown on the circuit diagram.

LOGICAL POSITION

This arrangement allows all bypass and decoupling capacitors to be placed around their logical position, the respective valve socket. Cathode resistors and bypasses from each socket lay against the side of the chassis and are earthed to the main busbar in each of the corners. Screen decoupling capacitors find a good place between the two sockets, the earthy end being returned to the socket spigots, which in turn are connected to the main busbar.

Screen and oscillator decoupling resistors are mounted on a terminal strip at the rear and con-

UNDER CHASSIS OF CONVERTER



The 3 coils are staggered in order to avoid mutual coupling between them. Leads are no longer than would be the case, if a switch were used and are carefully placed so as to avoid any coupling, which would cause instability. As mentioned in the text, all trimmer adjustments can be made from above the chassis. Core adjustment is on the sides, so that you need not turn the chassis upside down to align the converter. For the same reason the output transformer is also tuned by a trimmer instead of its own iron core. This would be inaccessible, owing to the output lead.

nected to the pins with spaghetti covered leads.

In a similar manner, the oscillator decoupling capacitor is placed near the coil, as well as the oscillator RF bypass. The oscillator grid leak and stopper resistor are soldered directly to the pins. Note that there is no standing bias on the oscillator grid, so that the grid leak is returned to the cathode pin.

Some care is necessary when mounting the trimer tuning the output coupling coil into position. The trimmer is "hot", i.e., it carries the full high tension. Adequate clearance should be left for the adjusting hole, otherwise the aligning tool would short the HT to chassis.

OUTPUT TRANSFORMER

The output coupling transformer, actually an ordinary broadcast aerial coil, mounted just behind the gang, is connected "back-to-front". This means, that the original secondary is used as a primary winding, connected into the plate circuit. The two pins to this winding, usually marked "G" and "F" are near the rear wall of the chassis.

One side of the original primary, now used as the secondary winding, is earthed, and the other connected to the changeover switch, to provide a high impedance source for the aerial input of the main receiver.

Commercially made 13-42 meter coils have been used in the prototype, which, with a minor modification, work very well. Similar iron-cored formers are, however, available, and winding data is given at the end of this article for those who wish to wind their own coils. The iron cores are necessary for alignment, which would present considerable difficulties otherwise.

There would be no objection to using 16-50 meter band coils if the extended low frequency coverage is desirable.

The modification referred to earlier is the removal of approximately ¼ turn from the oscillator secondary, and about 2 turns from the padder end of the primary. The smaller number of secondary turns allows the oscillator coil to be tuned 1600 Kc higher than signal frequency (instead of 455 Kc higher), bringing the coils closer to ideal tracking. The smaller primary reduces the grid current to near the specified value for the 6AE8, namely, 300 microamps.

COIL MOUNTING

You may have noticed that we have so far not mentioned much about coils. They are mounted over some of the components and connections, the aerial coil next to the front panel, and the oscillator coil in the rear corner on the same side. Opposite them is the RF coil in the centre of the left-hand panel. In order to prevent damage to them by the hot soldering iron, it would be wise to mount the coils last.

The coils have been deliberately placed some distance apart, both to make room for a switch, and also to reduce coupling between them.

This makes the leads to the RF coil rather long, but, if the 6BA6 plate lead is kept as far as possible from its grid lead, no trouble from feedback should be experienced. It must be remembered that, if the capacity between these leads is excessive, the RF stage will act as a tuned-plate, tuned-grid oscillator, which is a highly undesirable state of affairs.

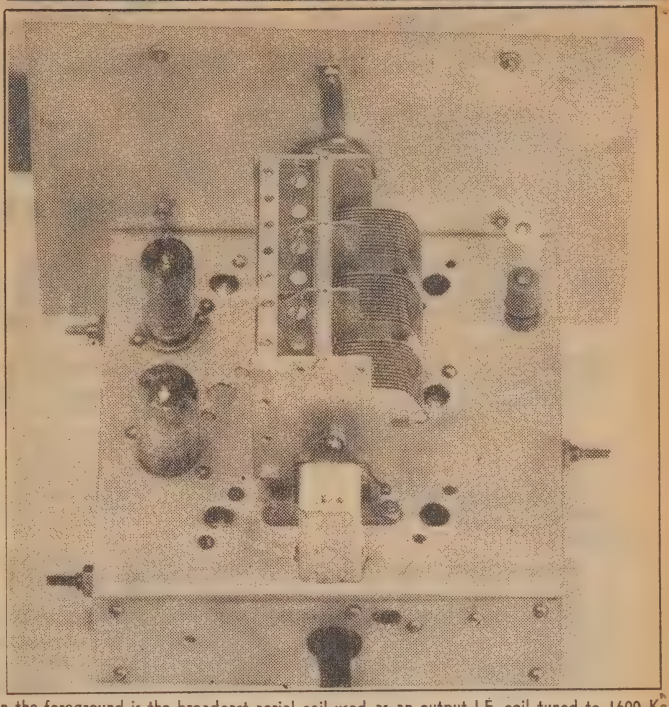
There is just one more point about the construction, which may be helpful: when connecting the output lead to the changeover switch, the braiding should be connected directly to the earthing busbar, and not to one of the earthed terminals on the aerial coil nearby. This is another safeguard against instability.

You may rightly ask, how it is possible that input and output being switched on the one switch does not cause feedback? Well, the output leads are well screened, and the capacitance across the switch is quite small. Besides, even at its lowest setting, the aerial circuit is tuned to a frequency some six megacycles above the output. Any feedback at such frequency difference would be rejected by the tuned circuits.

For the not-so-experienced constructor here is another handy hint: When wiring the converter, take good care to earth the outside foil and the outside plate of capacitors and trimmers. On paper capacitors, this connection is marked by a ring on one end, while on trimmers it is the plate which comes into contact with the adjusting screw.

Preventing accidental radiation from a bypass capacitor, this measure contributes to the overall stability of the converter, which is so essential for this type of apparatus. If the top plate of a trimmer is "hot", the capacitance of the aligning tool may be sufficient to make alignment extremely difficult.

TOP VIEW OF SW CONVERTER



In the foreground is the broadcast aerial coil used as an output I.F. coil tuned to 1600 Kc. The valve nearest to it is 6AE8. The other, 6BA6. Adjustable iron cores for tuning coils are seen projecting from the sides of the chassis.

Alignment procedure is the same as for any ordinary superhet, although, to get the last ounce of sensitivity out of the converter, the use of a signal generator is recommended.

If aligned correctly, the sensitivity and selectivity equal that of a good communications receiver. A lot, of course, depends on the amount of amplification the signal receives after entering the main set. Tested on a receiver, which had an RF stage as well as an audio stage, excellent sensitivity figures have been obtained. It need scarcely be pointed out that a good aerial helps.

FEEDBACK

Owing to the high sensitivity it would be advisable to place the converter some distance away from the main set. The connecting wires should be at least two feet long, to prevent stray radiation from either unit reaching the other. As some RF valves may be microphonic, this also helps to prevent audio feedback causing trouble.

For readers who prefer to wind their own coils here are the required details:

All coils are wound on standard formers, ¾in dia, 2in long, with adjustable iron dust cores. Core travel is ½in, with the core about ¼in outside the winding in the outermost position. On most formers this places the start of the winding about 1in from the adjusting end. Spacing 16 turns per inch.

(Continued on Page 95)

PAINT YOUR CHASSIS

DID you know that rust and atmospheric corrosion damage nearly as much metal yearly as is manufactured in the whole world today? Chassis for radios and electronic apparatus, being made of metal, are also subject to damage by rust and corrosion.

The best protection the home builder can give to chassis is a good coat of paint or lacquer. Particularly if the receiver or other apparatus is to be used for a long period, it pays to prevent the formation of rust.

First of all, clean the chassis thoroughly of any spots of rust with some coarse emery cloth, and then smooth it off with a finer grade. A good cleanup with petrol, methylated spirits or thinners, will help to avoid paint blisters due to grease or dust adhering to the metal.

Duco, quick drying enamels and lacquers are all easy to use, one coat being generally sufficient for most purposes. They can be put on with a soft brush, or, with duco, sprayed on, making a very nice job.

You don't even have to have a spraying plant to do it, because for small work the household insect spray gun is just the thing. The correct mixture to use would be one part of duco and two parts of thinners.

Even ready made chassis, which normally have a coat of paint, can be so heated, because the surface is invariably scratched by the time the chassis have been adjusted to individual requirements.

If earth connections have to be made to the chassis however, the paint will have to be removed at the connecting points, to ensure a good metal-to-metal contact of the earthing.

ARTIFICIAL PEARLS

The first fine artificial pearl made in Western Europe was produced by Jacquin, a rosary maker, of Paris. Coating the inner surface of a thin, opalescent glass sphere first with parchment sizing, then with pearl essence, he filled the hollow middle with white wax. This was the beginning of the imitation pearl industry, but it did not greatly affect the gem market. However, in the 1920's the Japanese began to export cultured pearls, and it caused a panic among dealers until experts found ways, including xray, to tell the difference between the natural and cultured products. The Chinese first used pearl culture as early as the 13th century. Dating from this period are tiny Chinese-made pearl images of Buddha. The first perfectly spherical cultured pearl was produced by the Japanese only in 1909. To stimulate the formation of a cultured pearl, a small object is placed into the oyster, and the creature does the rest by building up layers of nacre around it. However, to produce a cultured pearl of good quality, the oyster must be guarded in underwater cages and carefully protected from sicknesses.

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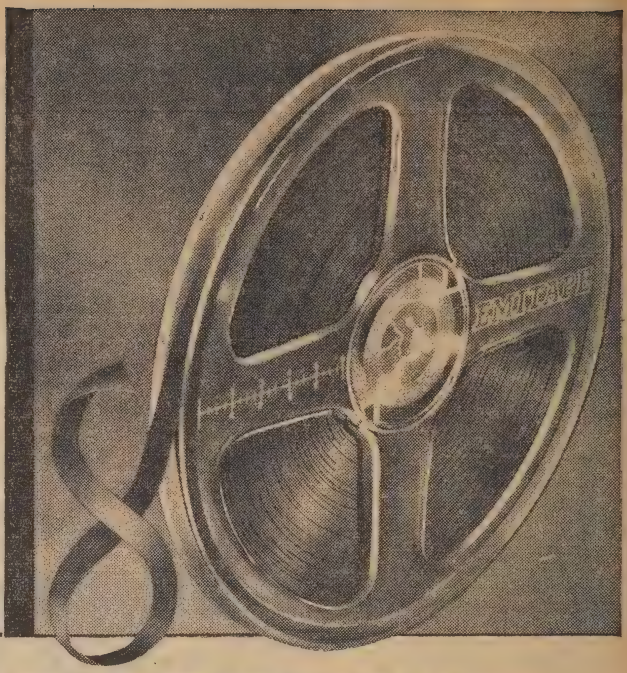
ANNOUNCE



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FROM THE SERVICEMAN WHO TELLS

Before delving into specific technical problems this month I suggest you read the letter published elsewhere in the article. As you can see it is from a fellow serviceman—one with a grouch about the design of some of the commercial sets with which he has had to deal.

AT this stage I don't intend to comment at great length on the points raised; instead I am simply presenting them to be read by other servicemen—and set designers—and to provoke whatever comment they will.

One point is fairly clear, however. It is unlikely that I will ever be in a position to give various brands "the works" as my correspondent suggests, desirable and all though such a course may appear at first glance.

For one thing, am I, or any other single person, really competent to undertake such a job? Would such an opinion really be fair and unbiased? I am flattered to learn that F.J.C. thinks it would, but I am afraid more sober reflection suggests otherwise.

BIASED CRITICSM

A more likely result of such an attempt would be a criticism strongly biased in favor of servicemen in general and yours truly in particular. And that, while it might enable us to air a lot of grouches, would hardly be a fair overall picture of any particular set.

After all, there are many sides to the question and the serviceman sees only one of them. By the very nature of his job he sees more bad sets than any other kind, the good ones sitting snugly in their lounge-rooms year after year without so much as blowing a dial lamp. For this reason it is very easy for him to develop an "all sets are bad" prejudice, which is entirely unfair.

Because there is more than one side to the story, we would find that for nearly every criticism the serviceman could level at the designer, the designer would have a very convincing counter argument involving such things as production costs, customer demand in matters of size and shape, records of previous failures of various components, and so on.

I SYMPATHISE

Not that I do not sympathise with Mr. F.J.C. On the contrary, like him, there have been many times that I have sweated over the replacement of a near inaccessible component and expressed the desire to wrap the set around the designer's head, or adapt it for some even more fiendish form of torture.

But we must keep a sense of proportion in these things. Every difficult replacement job does not necessarily imply a badly designed set, for the need to replace the component may be an exception rather than the rule.

Poor workmanship is another matter again and a few isolated cases, deplorable though they may be, are hardly justification for condemning the design as a whole. Which makes it hard, to say the least, for anyone to give a fair criticism of any set.

So there it is. It all depends on which side of the fence you sit and, for the moment, I'll sit right on the fence itself. Has anyone else any ideas?

On the technical side I have a story of a car radio. As far as I am concerned it must come pretty close to establishing some kind of a record, for it had more faults contributing to the same symptoms than any other set I have ever handled.

The owner's story was that it was noisy and subject to fading. Sometimes, when first switched on, it would play quite well, then fade away. Sometimes it could be restored by giving it a sharp kick, at other times it would remain in its weakened condition.

The noise was in the form of a "frying" or "scratching" sound which varied from a moderately high level —enough to make listening definitely unpleasant—to a faint but annoying background.

According to the owner the noise varied with the movement of the car; turning left seeming to make it worse, but turning right having little effect. As with the fading effect, it could sometimes be improved by administering a sharp kick. (Such is the treatment handed out to extremely delicate apparatus in this electronic age.)

The owner was a motor mechanic by trade and knew enough to recognise a broken joint if he saw one, though this was about the limit of his knowledge. He had taken the set out of the case about three times and on each occasion had found a faulty connection—the same connection—and had resoldered it. He had checked the aerial for obvious defects, but had found none.

WHERE I CAME IN

With this background of the set's history I was asked to see what I could do. I didn't feel any too keen, as I consider that there is only one thing worse than an intermittent—and that is an intermittent in a car radio.

However, this kind of prejudice

A SERVICEMAN WITH A GROUCH!

I am sure you could do the public of Australia a great service, not forgetting the long-suffering serviceman.

Could you not, each month, give different models of radio sets, &c., the works? Do not pull any punches. If the designer ought to have it wrapped around his head, say so. At the same time give praise where it is due.

As one who has to perform all service in the field and is denied the luxury of a work bench, here are some of my gripes:—

The sets that are almost impossible to service. The designers of these has only to study some R. and H. designs if he has no imagination and, as a humble mechanic, I am sure I could do better. These blokes have never heard of point to point wiring. There is some excuse in the vintage sets, but not nowadays.

I realise that a manufacturer has also to make his set attractive and has to study production costs, but as a classic example to prove that it can be done there is a very popular and attractive five-valve mantel for the price of a four-valve now on the market, with the layout very neat and efficient and production costs down.

Don't some manufacturers realise that their sets have to be serviced, also we servicemen sell to augment our income? To put it mildly, there are some sets, well-known makes, too, that I would not sell to my worst enemy.

I have had some experience servicing TV sets in London and all I can say is: God help the poor serviceman if some of the manufacturers make their TV sets like their radios.

Cocktail radiograms and grams with the backs NAILED on with dozens of small veneer pins; shielded gram leads, &c., nailed to the cabinets with electricians' nails so hard that it is impossible to prise them up without damaging the leads; no interconnecting plugs and sockets in grams; holes punched in the chassis and all the hot leads passing through with no rubber grommets are seen quite often; dial drives that only just work when they leave the factory.

Pinch-penny tactics like these should be exposed.

I averaged about 15 calls per day for the past two and a half years in my present job so I can speak with a little experience.

This is the first time in my life I have written a letter of this nature but I feel that the Serviceman Who Tells can add quite a bit to this. I could contain myself no longer.—F.J.C. (Parramatta, NSW).

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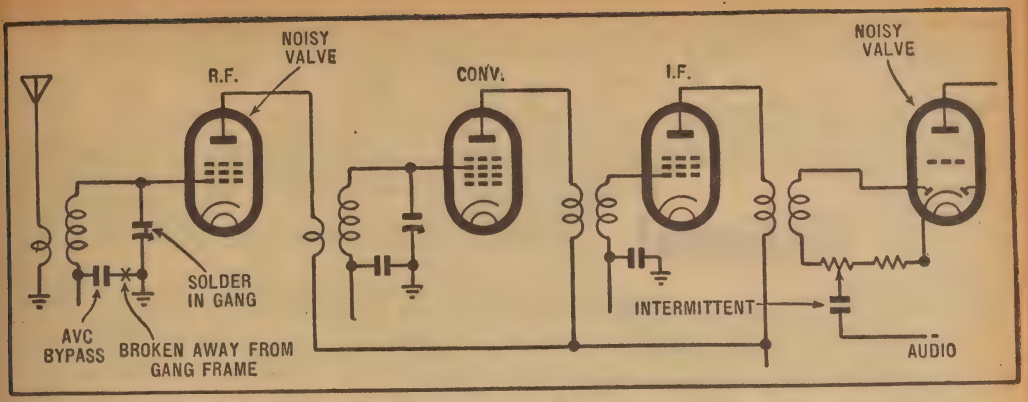


Is this a record? All the faults shown above, plus one in the power supply, were contributing to a noisy receiver. With one exception, that of the noisy 6SQ7, they were all present at the same time. The 6SQ7 packed up immediately all the other faults had been corrected.

won't pay the shop rent so I said I'd have a go at it. Had I known what was in store I would have been even less keen.

For a start we went for a run in the car. First point that struck me was the poor sensitivity for a set of this type, normally one of the hottest there is. This fact gave rise to a lot of fading due to changes in location, it being obvious that the set did not have enough gain to cope with the poorer spots.

I couldn't be sure whether this was the fading to which the owner had referred or not, but he was definite that he had observed the effect while the car was stationary, thereby suggesting that it was due to some other cause.

NOTHING OBVIOUS

The noise showed up after a while in the form of an erratic crackling. I tried to relate it to the car's movement but without much success. The only point I established was that it was controllable by the volume control, thus suggesting that it was in the front end.

Back at the shop I checked all the visible connections, including the aerial, but without finding anything significant. Certainly the aerial connection was not the best and due for an overhaul, but it was not the cause of the trouble.

Next thing was to get the set on the bench and find the cause of the poor sensitivity, hoping that the noise would show up at the same time. The owner gave me a hand to get it out of the car and I suggested he stand by while I opened it.

I reasoned that any joint which had been repaired on three separate occasions warranted investigation and I wanted to know exactly where it was.

AVC BY-PASS

As it was I need not have bothered for as soon as I opened the case the owner pointed to a condenser hanging loose and said, "That's the one, there seems to be no way of keeping it in place."

I soon established that it was one of the AVC by-passes and the reason for its continual failure was not hard to see. The earth connection had been made to the gang frame and this was free to move by reason of its rubber mounting. Considering the vibration normally encountered in a car set, it is little wonder that the connection continually failed.

How it came to be like that I was unable to discover. I know the particular set well enough to know that such was not a normal arrangement and the owner was definite that he had simply replaced it as he had found it. I can only assume, therefore, that someone else had serviced the set at some time and was not particularly fussy about such matters.

Anyway, I made sure that such a failure would not occur again by earthing the condenser to a logical point on the main chassis.

But a test on the bench was not very heartening. The gang still seemed very touchy and sensitive to mechanical vibration, it being possible to vary the signal strength considerably by exerting pressure on it.

It took me a few minutes to locate the cause, but I eventually fished out a small blob of solder from between the plates of the aerial section and which had been shorting intermittently. It had obviously been dropped there by the owner during his previous repairs.

Returned to its case and tested on the bench the set performed very well with plenty of gain and no sign of crackles. I had high hopes that it might be completely cured.

But it was not to be. Mounted back in the car the set performed well in terms of sensitivity but had commenced its crackles and splutters once again. Apparently the tension of the mounting bolts had been sufficient to flex the chassis and start the trouble off again.

INTO IT AGAIN

I dropped the set off its mounting bolts onto the floor of the car and commenced to probe and tap. The RF valve seemed to be the most sensitive and I replaced this with a known good one. This produced the rather indefinite result of not seeming to reduce the noise appreciably, yet shifting the sensitive area away from this portion of the chassis.

The trouble now appeared to be centred around the IF valve, it being possible to start and stop the noise by moving this valve in its socket. I checked the socket and all its connections without result. However, the movement of the socket pins was conveyed, in various ways, to quite a number of other components and careful probing seemed to throw suspicion on a group of components around the diode circuit.

By this time I was getting nicely cramped in the front of the car and decided it was time I returned it to the bench. Here I tackled the suspected group of parts again, this time narrowing the trouble down to a coupling condenser.

It had all the symptoms of a faulty connection to one end of the foil and I promptly replaced it. This seemed to stabilise this part of the circuit but, strangely enough, the suspected condenser tested OK on the bridge and leakage tester.

PUZZLE

All this was rather puzzling and mysterious and I can't be quite sure just how much it was contributing to the overall noise level. For one thing the noise itself was by no means constant in level, which made it just that much harder. After you have concentrated on noises like this for a lengthy period you find it hard to remember exactly how bad it was originally, and I had just about reached this stage.

The most likely explanation seemed to be that the condenser had been at least partially defective — intermittently — and that it was varying the gain of the set and adding a few clicks and crackles of its own at the same time.

The important thing was that there was still an objectionable level of frying and crackling and I seemed to be making slow progress in clearing it up completely. The only difference was that the chassis was no longer sensitive to tapping, a fact I regarded as something of a mixed blessing at this stage.

THE POWER SUPPLY

I went over each component again, probing and tapping, but found nothing until I reached the power supply section. Here there seemed to be something touchy and I traced it to a LT RF choke, just a single layer winding of heavy gauge enamel wire. The connection

to one end was very doubtful and the noise could definitely be controlled by exerting pressure on it.

I re-soldered the joint and tried the set again. This time I seemed to have struck the jackpot, for the set performed perfectly on the bench and seemed quite immune to moderately violent vibration.

I put it back in the car, tested it again, and it still worked perfectly. Then we took it for a test run — and there was the noise almost as bad as ever. I say "almost", because it seemed to be less severe than the previous worst effort, though this was small consolation after the work I had put into it.

FAULTY VALVE

Back at the shop we dragged the set out of the car again and dumped it on the bench. Again I opened the case and set it up for test, then commenced the tapping routine all over again. I didn't have far to look. The chassis was very touchy again and I soon traced this to the vicinity of the 6SQ7 valve.

The valve itself proved to be very sensitive and the trouble vanished as soon as I replaced it. Then back to the car, the inevitable fiddling with mounting bolts, a check with the car stationary, and then another test run — with the fingers crossed

This time—at long last—we were unable to detect any noise even when the car was deliberately driven over poor roads and the set given a pretty thorough pounding as a result. After that I considered we had tempted fate far enough and pronounced the job complete. Frankly, I wanted to get as far away from the thing as I could before something else packed up!

In fact, I needn't have been so scared because the latest report from the owner indicates that everything is still OK and the set performing perfectly. May it stay that way.

And just what is the explanation of all the puzzling effects I encountered? We can skip the broken AVC by-pass connection and the blob of solder as being self-explanatory, the noise problem being the really interesting story.

As far as I can make out each of the faults I have enumerated was contributing its share of noise, in some cases a lot, in others only a little, the joint effort adding up to a substantial level.

This would make it hard to appreciate the effect of curing only one fault, since there would still be a number of other sources and the reduction in level would be small, particularly when we remember our decibel laws, &c.

HARD TO OBSERVE

Thus the replacement of the noisy RF valve did, in fact, reduce the noise but I was unable to observe it. All that I was able to observe was that it was no longer possible to deliberately generate noise in this section.

In a similar manner it was difficult to observe the effect of replacing the faulty diode coupling condenser. In any case it seems likely that this was only a small contributor.

The faulty LT RF choke connection was probably one of the biggest contributors or, again, this may simply have appeared so by reason of its being the last fault to be cleared, at least in that particular batch.

As for the noisy 6SQ7—well, I am convinced that it was simply put there to make it harder. Why it was able to withstand all the probing and tapping I handed out to the chassis without giving out the slightest whisper and yet pack up as soon as I put the set back in the car will forever remain a mystery. But there it is, that's what gives servicemen grey hairs. (That's if he has any to go grey!)

Another puzzling case I encountered recently could also come under the general heading of intermittent, in that I could not exactly duplicate all the symptoms which the users had observed.

The device was a semi-portable PA system intended for operation from either the mains or a six-volt accumulator and which belongs to a local social group. In addition to their own activities it is frequently loaned to other groups; altogether, it gets around quite a lot and is handled by all and sundry, invariably non-technical types.

Although I didn't get the full story until later it seems that the unit had been giving trouble, intermittently, for some time. Thus one user would report perfectly satisfactory operation while another would complain that the thing was quite dead. After a few such cases the person in charge came to the conclusion, rightly as it turned out, that all the complaints were from persons who had used battery power.

Reasoning that it was probably only a flat battery he arranged to have this charged before the system was required again and assumed that all would be well. In fact, he might have saved everyone concerned a lot of embarrassment had he sought technical advice there and then.

IMPORTANT FUNCTION

As it turned out the unit was next required for the Anzac Sunday service conducted by the local RSL at the district War Memorial.

It was duly transported to the spot, complete with fully charged battery, and set up a few minutes before the service was to begin. Imagine the consternation of all concerned when it was found that not a whisper could be coaxed from it and the service had to proceed without any voice reinforcement of any kind.

This was where I came into the picture because the unit was wanted again in the afternoon for a similar function. Thus it was that, with due apologies for disturbing me on a Sunday, those in charge asked me if I could possibly help them out and get the thing going in the short time remaining.

Appreciating the nature of the cause, it seemed the right thing to do and I agreed to do what I could. I managed to piece together the history of the troubles, more or less as I have already related it, and then tackled the thing itself.

When first connected to a battery the thing was completely dead, no filament power, no vibrator action, "no nuthin". This proved to be due, at least in part, to a blown main fuse in the LT circuit. I immediately suspected a faulty vibrator and fully expected that the new fuse I was fitting would probably blow again as soon as I switched on.

Just to make things harder it remained intact and the filaments came to life. But that was all that happened for it still showed no other signs of life. I put my hand on the vibrator and realised that it was not working, at least for a second or so, because the action of touching the cartridge was sufficient to set it vibrating.

IT WORKED

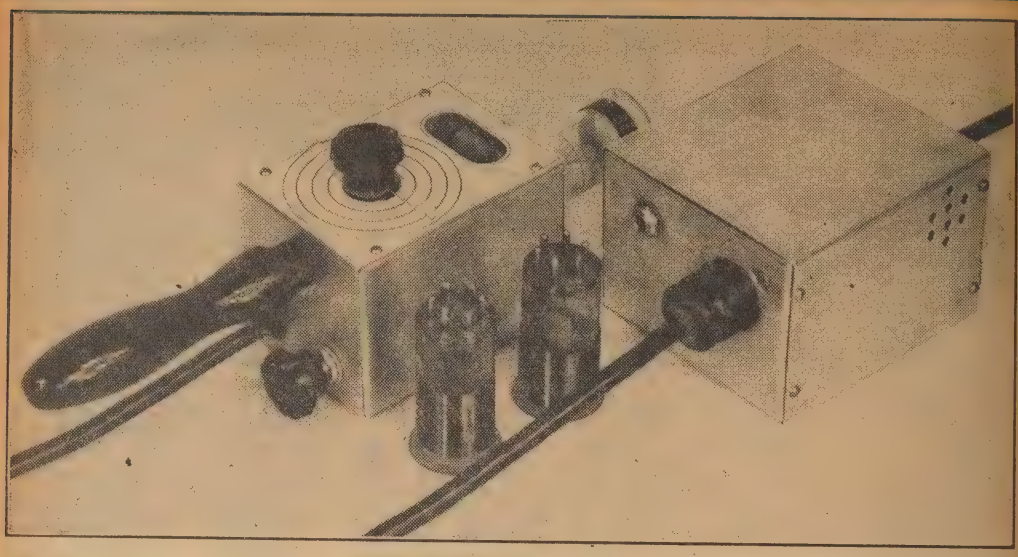
Naturally everything came to life as soon as this happened and I decided that a new cartridge was probably all that was needed. Unfortunately I had nothing like it available and I hoped it could be coaxed into working long enough to see the afternoon program through.

As far as I could judge it was a slight movement of the cartridge that caused it to start, suggesting a possible fault in the socket. Examination of the socket revealed no obvious fault but I took the precaution of adding a little extra tension to the prongs and cleaning the vibrator pins, although this latter appeared hardly necessary.

Then I tried switching the unit on and off a number of times and obtained a positive start every time. This seemed to suggest that there might have been something wrong with the socket, though it did not explain the blown fuse.

On that score I could only think of two possibilities: (1) that the

(Continued on page 113.)



The new grid dip oscillator with its power supply and some of the coils. The knob below the handle is the sensitivity control and the cable beside it the power cable. Note the aperture above the dial scale through which the indicator is viewed.

AN AC GRID DIP OSCILLATOR

Here is our latest version of the grid dip oscillator, that extremely versatile piece of test equipment so frequently needed by the "ham" or advanced experimenter. AC operated and using a tuning indicator valve it is extremely simple to build and use.

by Philip Watson

THE main function of a grid dip oscillator is to determine the resonant frequency of any tuned circuit and—most important—without the need for that tuned circuit to be energised by its associated equipment.

This is really the unit's most valuable feature, since other forms of checking, such as signal generators, wave meters, &c., all require that the equipment be capable of being switched on.

By being able to check the tuned circuit before it is energised it becomes very much simpler to wind coils for transmitters and receivers and, in fact, it is possible, roughly, to align the equipment, stage by stage, before it is put into operation.

TRANSMITTER DAMAGE

In the case of transmitters, it is particularly undesirable that those stages handling any amount of power be allowed to operate in a de-tuned condition, since they can easily run into serious overload with the risk of permanent damage. Using the grid dip oscillator it is possible to tune all stages to within "a whisker" of their optimum setting before it is ever switched on.

This is much more satisfactory than trying to "prune" the circuits when energised from their own circuitry, since there is no risk of bites, no possibility of radiation outside the band, and no risk of overloads and damage.

And how does it achieve all this? The grid dip oscillator can be any simple oscillator with facilities for coupling it to the circuit to be measured. It is calibrated as accurately as possible and has some form of indicator, usually a meter, connected to its grid circuit to indicate the strength of its grid current.

This indicator is the key to the instrument's operation, since the strength of grid current will depend, among other things, on the amount of energy being absorbed by adjacent circuits. Thus, when the oscillator is coupled to a tuned circuit adjusted to the same frequency as the oscillator, the energy which it absorbs will reduce the strength of oscillation and the grid current.

If, therefore, we couple the oscillator to an unknown circuit and tune it across the band, the grid current will suddenly decrease or "dip" as we pass through the frequency of the circuit. Hence the name "grid dip" oscillator. We have now only to refer to our calibrated scale and read off the frequency of our unknown circuit.

While it is necessary in practice to observe a few simple rules there is nothing complicated about using the instrument, and it is usually only the work of a few moments to determine the frequency of a circuit or adjust it to a required frequency.

PREVIOUS DESIGNS

We originally described a grid dip oscillator in Radio and Hobbies for April, 1950, followed by a slightly modified version in March, 1951, and a VHF attachment in September, 1951. These units have proved their worth time and time again, both in our laboratory and individual ham shacks. Once having used the device we wonder how we ever managed without it.

These units were battery operated and entirely self-contained, a feature which many users regard as extremely valuable. The indicator was a small milliammeter of

0-1 range or thereabouts, the smallest available type being used.

While this version has been extremely popular, there is another approach to the problem; that of an AC operated unit, having a separate power supply and using a "magic eye" type tuning indicator in place of the meter.

Even though AC operation restricts the use of the device to positions where power is available this is not usually a serious limitation. On the other hand there are several advantages. While the power required to operate the battery unit is small and the period of operation usually short, battery replacements can still be expensive.

SHELF LIFE

All batteries have a definite shelf life and the HT types are usually worse in this regard than the common torch cell. Thus the ham who must share his amateur activities with other hobbies, and who may not use his equipment for months at a time, may well find that he will obtain very little of the battery power that he has paid for, most of it being wasted in self-deterioration.

There is also the weight of batteries to be considered, it being possible to make a very much lighter unit when the power supply is separate.

The use of AC makes possible the electronic indicator in place of a meter which also offers several advantages.

One of these is their rapid response since unlike a meter, they have no inertia and will respond instantly to the grid circuit changes.

Using a meter, it is quite possible to pass over a dip so rapidly that the meter cannot respond to it, particularly on the VHF bands. This can never happen with a tuning indicator, which is faster than the fastest operator.

The indicator is also unharmed by overloads, making it possible to set it for high sensitivity on one range without the fear that it may be damaged when another coil is plugged in.

There is also the matter of cost, and the indicator is only a fraction of the price of a meter.

So much then for the general picture; now for some details of the unit. The actual oscillator circuit is similar to that used in our original battery version, being a slightly modified version of the well-known Colpitts oscillator.

SUITABLE VALVES

There are several valves which make good HF oscillators, many of which have been available through disposals and which readers may have on hand. Typical examples are the 6C4 and the 6J6, the latter being a twin triode and probably best paralleled into one triode. Other suggestions are the 6AU6 and the 6AG5, triode-connected in both cases. So far we have not had time to check these types but if you have them on hand, we suggest you try them before investing in a new valve.

We tried both the 12AT7 and the 12AU7 as single and parallel triodes, finally settling for the 12AU7 as being a smoother and more consistent oscillator. The 12AT7 will work but its activity varies considerably with frequency, causing spurious dips which can be misleading. The 12AU7 simply varies slowly from one end of the band to the other.

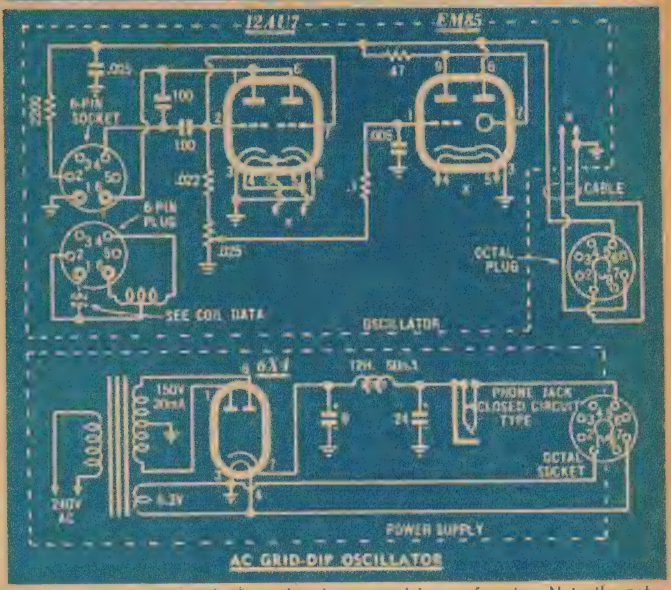
Although a single triode section of the 12AU7 will work quite well, better results are obtained with the two in parallel. However, if you have one with one "dud" section, by all means try it.

For an indicator tube we used one of the latest types which has some advantages over the older ones, at least for this class of operation. It is the miniature EM85 which requires very little space and has its fluorescent target so placed that it is viewed from the side rather than the end, as in previous types. This simplifies the mounting problem and makes it ideally suited to our purpose.

The indicator is operated from voltage developed across the oscillator grid resistor and we soon discovered that there was far more than we required. This meant that the pattern overlapped and that the triode amplifier portion of the indicator was being driven into its non-linear and least sensitive region, resulting in a very weak response.

Tapping down the grid resistor

GRID-DIP OSCILLATOR CIRCUIT



The circuit is quite straight forward and uses a minimum of parts. Note the pot. in the oscillator grid circuit to act as a sensitivity control. Although a 12AU7 is specified, other oscillator valves may be used, as mentioned in the text.

PARTS LIST

- 1 Box 3 1/8in x 3 1/8in 4½in.
- 1 Box 3⅜in x 4½in x 4½in.
- 1 EM85 valve.
- 1 12AU7 valve.
- 1 6X4 valve.
- 1 9 pin miniature socket (ST29) See text.
- 1 9 pin miniature socket (ST19)
- 1 Octal socket.
- 1 7 pin miniature socket
- 1 Closed circuit phone jack.
- 1 6 pin socket.
- 1 Octal plug.
- 7 6 pin 1½in coil formers.
- 1 Power transformer 150/V 30 mA 6.3V 2A.
- 1 Filter choke 12H 50 mA.
- 1 reduction drive with insulating bushing.

RESISTORS

- 1 .47 meg. 1W.
- 1 .1 meg. ½W.
- 1 .025 potentiometer.
- 1 .022 meg. ½W.
- 1 2200 ohm 1W.

CAPACITORS

- 1 24 mfd 350V electrolytic.
- 1 8 mfd 350V electrolytic.
- 2 .005 mfd 350 volt paper.
- 4 .001 mfd paper or mica.
- 1 100 pf mica.
- 1 100 pf tuning capacitor.
- 1 wooden handle.
- 2 Instrument knobs.
- 2 3-terminal tag strip.
- 1 7-terminal tag strip.

3-core flex, grommets, solder lugs, nuts and bolts, hook up wire, winding wire, &c.

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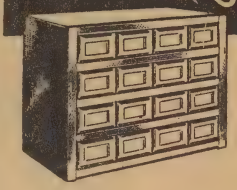

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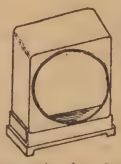

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to the point where the pattern is about three quarters closed will overcome this and appears to give maximum sensitivity. Since the oscillator activity varies considerably from band to band, and to a lesser extent from one end of a band to the other, it is impossible to specify an optimum tap to suit all conditions.

Instead, we have made part of the grid resistor in the form of a potentiometer, which may be quickly adjusted to give best results. This idea works very well and usually only needs to be set once for each band, unless a particular response is very weak.

DECOUPLING

To prevent any of the RF oscillations reaching the fluorescent target and impairing the pattern, the grid of the indicator valve is decoupled from the oscillator grid resistor by means of a .1 meg resistor and a .005 capacitor.

The coils are plugged into a six pin socket and the specifications may be similar to those for the battery version. In fact, we used the original battery coils to test this unit. However, we have ideas about winding the VHF coils on small formers to facilitate coupling to the small coils normally found on VHF gear. This will probably entail mounting small coil formers on standard six pin plugs and we might have more to say on this subject at a later date.

As with the battery version, we found that the three highest frequency coils performed best when the centre tap was not by-passed, while the lower frequency units required it. This is overcome by incorporating the by-pass in the coil former, using one of the pins for an earth connection.

A set of seven coils will cover from the 455 Kc IF channel, through the broadcast band (in two sections), and up to 80 Mc. For higher frequencies we have in mind to produce a separate head specifically designed to cover them.

The power supply is quite a simple affair using a 150 volt, 30mA transformer, a 6X4 rectifier, two electrolytics, and a small choke. Although the filtering may appear to be rather more elaborate than warranted for such a simple piece of equipment, there are two reasons why it is desirable to keep the hum down to a reasonable level. One is to ensure a clear pattern on the screen and the other is to permit a pair of headphones to be connected in the plate circuit of the oscillator valve.

This latter facility makes the unit into a heterodyne frequency meter, the audible beat between the oscillator's own oscillations and those from any other source being present in the headphones. Although this is not a major feature, it is a useful one if only to facilitate the calibration of the unit against a signal generator or similar source.

Our power supply delivered about 175 volts on load and any voltage around this figure should be satisfactory.

Coming to the actual constructional side, there are a number of points to be considered. The oscillator is housed in a small metal box measuring 3-1/8in square by 4¼in long. In one end is mounted the coil socket so that the coil protrudes from the front of the box in a manner which facilitates coupling it to the circuit under test.

At the other end of the box is a handle, the indicator sensitivity pot., and the power cable. On the top of the box is the tuning knob, calibrated scale, and an aperture to view the indicator tube.

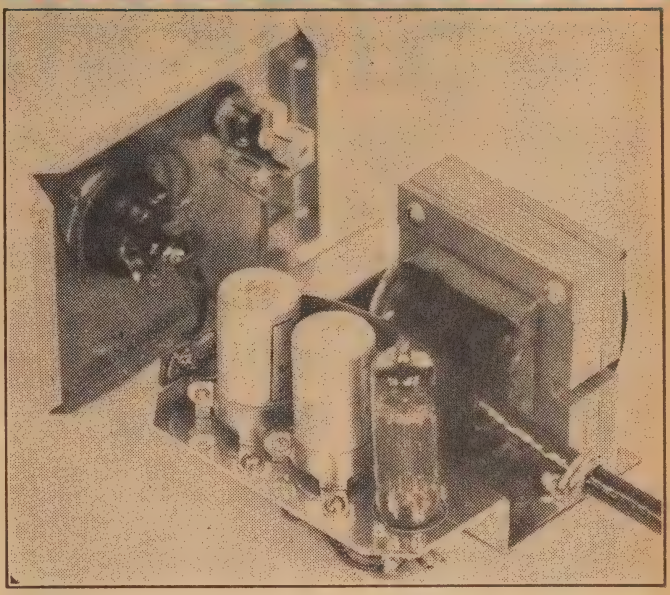
The indicator lies across the box in the front top corner and we arranged the position of the viewing cut-out and the mounting socket so that the screen of the valve will be most readily visible when looking over the top of the tuning knob from the rear of the box. This is the most usual position which the operator will occupy and the arrangement works out very well in practice.

Locating the indicator dial and the calibrated scale on the same face of the box is also an advantage, making it easy to check the response frequency without moving the instrument.

The tuning capacitor is a 100 pf type and should be the best you can obtain. Some of the better quality imported types featuring ceramic insulation are very good, both mechanically and electrically, and are well worth using if you can get one. Unfortunately, they are not in very plentiful supply and you may have to be content with something less ambitious. Just to show what could be done we used a locally-made unit of moderate quality which was never really intended for work of this kind and this seemed to work out quite well.

INSULATION

The circuit calls for this capacitor to be completely insulated from the frame and this involves the reduction drive from the tuning knob as well as its own mounting bracket. Insulation from the mounting bracket is relatively simple, requiring only the usual insulating washers. Coupling it to the reduction drive was another matter. We did not want to use an insulated flexible coupling, since it would have increased the size of the box.



The inside of the power supply. Note the stepped chassis to accommodate the rectifier and electrolytics. The octal outlet socket and the phone jack are on the lid.

COIL DATA

COIL A 80 to 33Mc
¾ turn, 20 B & S.

COIL B 34 to 14.5Mc
4 ¾ turns, 20 B & S, spaced 3/8"

COIL C 15 to 6.5Mc
11 turns, 20 B & S.

COIL D 6.5 to 3.0Mc
33 turns, 20 B & S.

COIL E 3.0 to 1.4Mc
54 turns, 32 B & S.

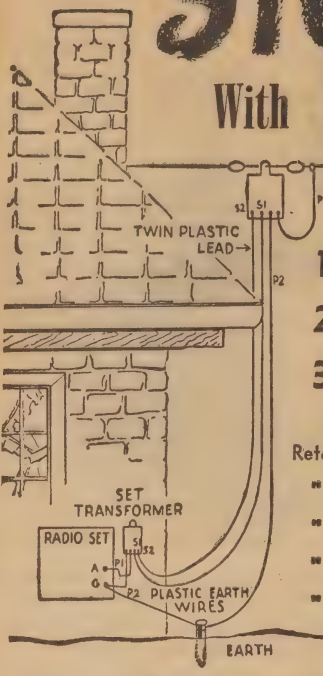
COIL F 1.4 to .7Mc
1 ¼" length 32 B & S.

COIL G .7 to .45 Mc
2 ½" length 32 B & S. 25 pf condenser in parallel with winding.

All coils wound at top of former.
All coils centre tapped. Centre tap of coils D, E, F and G bypassed to pin 1 with .001 mfd capacitor
All coils on 1¼" formers.

STOP NOISE IN YOUR SET

With R.C.S. aerial and line filters



MAKE THIS SIMPLE TEST:—

1. Remove aerial from set. If the noise stops, you need an AF21C aerial filter, as the noise is coming through your aerial.
2. If the noise continues, you need an LF20 line filter as the noise is coming through your power main.
3. If any of the appliances shown below are causing the noise, then fit to it a line filter of the type shown.

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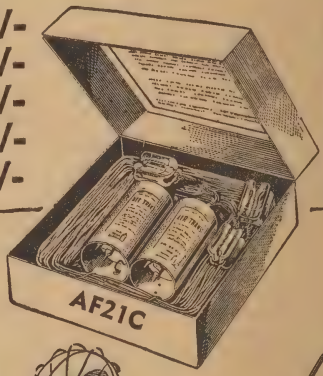
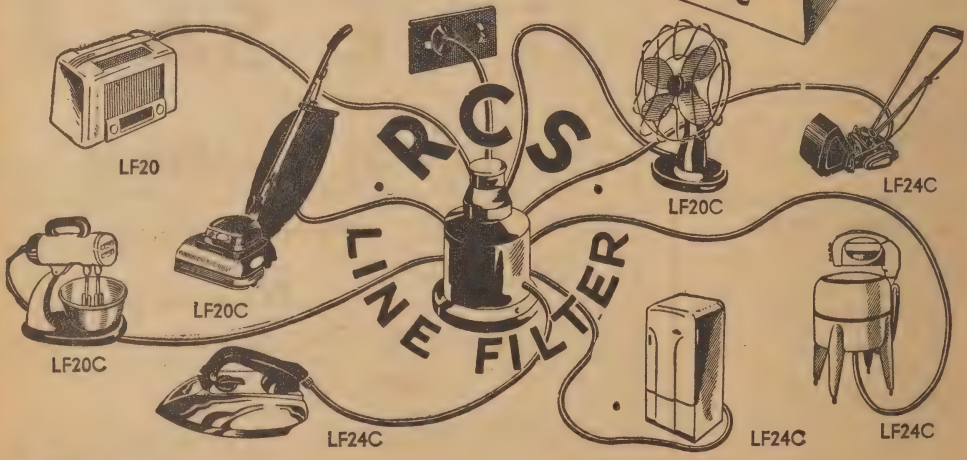


CONFINE NOISE WHERE IT STARTS — WITH R.C.S. LINE FILTER



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A solution was found in the fact that the reduction drive needed a bushing to reduce from 3/8in to the ¼in shaft of the tuning capacitor. From a scrap of bakelite tubing we managed to fashion an insulating reducing bush which solved the problem very neatly. To save our readers the bother of making this for themselves, we have arranged with the maker of the reduction drive to supply this item ready made.

We also pointed out that the simple "push on" type pointer mounting intended for the drive was not very suitable for a calibrated instrument. As a result an additional unit is to be marketed, and which is intended for test gear in general, consisting of collar and pointer which can be firmly secured to the drive by means of grub screws. The pointer will also be removable if it should be desired to fit a different type.

OFFSET POINTER

Our pointer was made from a scrap of clear celluloid and is in the form of a double sided offset pointer intended to facilitate the scale calibration. After the scale is calibrated we may substitute a more conventional pointer.

The scale itself is in the form of two semi-circular scales each of 180 degrees. By this means the necessary ranges can be accommodated in a small space without undue crowding.

Sockets for the EM85 and the 12AU7 are both mounted on a small bracket fastened to the front of the box. In order to mount the EM85 as close to the front and top of the box as possible it is necessary to "doctor" a socket. We used a moulded bakelite version (type ST19) and ground off the mounting lug nearest the gap in the pins. We also cut a short length from the central shield and removed pins number 2 and 8.

These precautions are necessary by reason of the proximity of the socket to the lid. The pins 2 and 8 are not used but are internal connections which may short if left free. Some of the other pins may need to be bent over or clipped short before soldering to keep them clear of the lid when fitted.

The 12AU7, being a shorter valve, may be mounted higher and this is achieved quite simply by using a different style socket (type ST29) which mounts above the chassis. No doctoring is required for this.

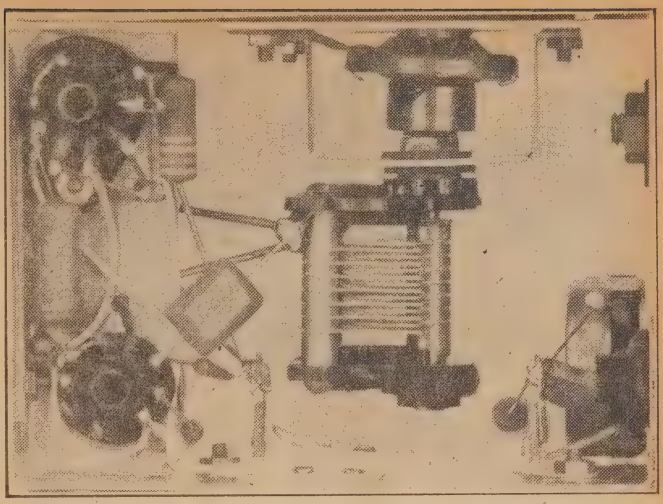
RIGID WIRING

The wiring associated with the tuned circuit should be kept rigid so as to minimise changes to the calibration. We used two heavy leads (16 s.w.g.) from the coil socket to the tuning capacitor, which provides some additional mechanical support for this latter. Most of the remaining critical connections can be completed with the pigtails of the components involved.

By using a common return lead for both filament and HT we were able to connect the unit to the power supply with a standard three-core flex. We selected a plastic-covered variety, similar to "cab tyre", but considerably more flexible. If this is not readily available, ordinary cotton covered flex will suit. Some form of strain clamp should be used to anchor the cable inside the box.

The cable is terminated on a tag strip (a seven terminal cut down to a lop-sided five), the other terminals being used for the oscillator grid resistor wiring to the pot. A three terminal tag strip near the oscillator socket serves as a HT point and to terminate the .022 meg. oscillator grid resistor.

A comfortable handle is essential for an instrument of this kind and



Close-up of the oscillator wiring. Top left is the indicator socket (suitably "doctored") and bottom left the 12AU7 socket. The power cable enters at bottom right and behind it is the sensitivity pot.

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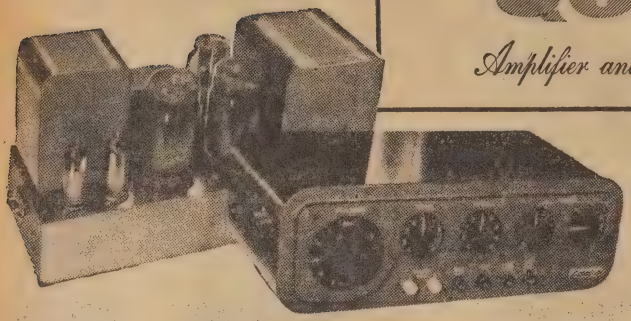

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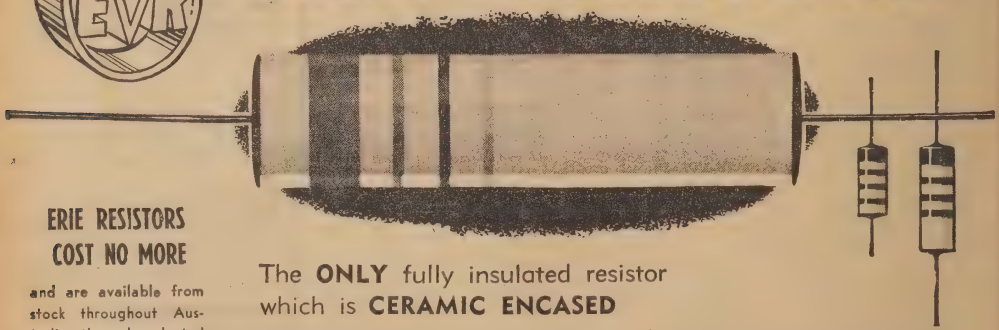

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we solved the problem quite simply by purchasing a 5in wooden file handle (price 6d), modifying it to mount on a metal box, and giving it a couple of coats of black lacquer.

If possible, obtain one which has only a small bore hole drilled in it, since this will permit a ¼in machine screw to be screwed directly into it. Make sure that a nut is fitted first, then cut the head off the screw, using the nut to clear the thread. With the addition of a ¼in brass washer the handle may be securely fitted to the box.

In our case the hole was a fraction too large to provide a secure thread, so we soldered a ¼in nut inside the metal ferrule, cut an appropriate amount off the handle, then secured the ferrule in place with a couple of panel pins.

The power cupply case is slightly larger than the oscillator, but we managed to retain the same size lids for both, thus simplifying the metal work somewhat. The increased size is in the width of the box, which is 4½in.

STEPPED CHASSIS

The components are mounted on a small stepped chassis, the power transformer and choke on the lower step and the rectifier and electrolytics on the higher one. Countersunk screws are used for the transformer and choke, thus enabling the chassis to sit flat on the bottom of the case. Four rubber feet and a small handle are suggested to complete the assembly.

The octal outlet socket and phone jack are mounted on one lid by short lengths of hookup wire. The phone jack needs to be insulated from the chassis, since both sides are in the HT circuit. In some types this will also mean that a HT point is left exposed on the outside of the chassis, and a type which avoids this complication is to be preferred. However, if it cannot be avoided, there is no real danger, merely the possibility of a sharp "bite" for the careless finger.

If you are worried over this point it should not be hard to fashion a simple protective shield which will allow free entry of plug but make it difficult to touch while handling.

Naturally, the completed instrument needs to be calibrated, and there are several ways of doing this. Since we haven't room to cover them all in detail in this article, we propose to hold this over until next month. At the same time, we may have some modified coil data for the VHF bands.

COIL DATA

In the meantime, we are publishing the coil data as used for the original battery version and which is also perfectly satisfactory for this version. If you can borrow such a set of coils they will serve for testing, or you may care to wind one or two of the simpler ones as a temporary measure. In any case, it is the data for the higher frequency coils which is most likely to be changed.

In using the instrument it will be necessary to make some kind of estimation at least of the band in which the unknown circuit is likely to fall and select a suitable coil accordingly.

When the unit warms up the indicator "eye" will give the usual green pattern on the target, the exact degree of closure depending on the setting of the sensitivity control. This should be adjusted until it is about three-quarters closed, a condition which our experience has shown gives the best sensitivity.

You are now ready to check your unknown circuit or coil and the oscillator coil should be coupled fairly closely to it. Tune over the band slowly, watching the indicator carefully. There may be a slow change of pattern as the frequency varies from one end of the band to the other, but this should not be confused with the response you are seeking.

RESONANCE INDICATION

When this occurs it will usually be quite a violent reaction, particularly on the lower frequencies, the pattern opening almost completely in most cases. The response may also be somewhat erratic and jumpy, but this is quite normal and is due to the close coupling between the two circuits. This causes "pulling" between the two resonant circuits or will even cause the oscillator to go out of oscillation.

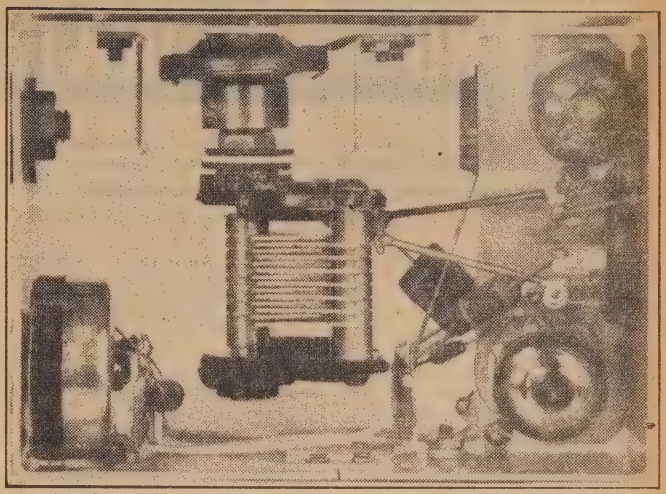
All this is quite in order, the close-coupled condition being used simply to identify the approximate frequency. To obtain a more accurate reading, the coupling should now be reduced while the oscillator is retuned. This will reduce strength of the indication, but it will still be possible to observe it and the coupling should be reduced until the pattern movement is barely perceptible.

Under these conditions the effect of the oscillator tuned circuit on the circuit being examined is at a minimum and greatest accuracy will result. In most cases it is possible to separate the two circuits by several inches and still obtain a faint, though useful, reading.

Which just about covers most of the points about this little unit and should enable you to go ahead and build it before next month's article. If you do any amount of serious experimenting, we sincerely recommend it.

We think you'll vote it one of the handiest instruments you have ever used.

A VIEW FROM THE OTHER SIDE



Another shot of the oscillator, this time from the other side. Top right is the EM85 and below it the 12AU7. The tuning capacitor is dead centre and the reduction drive can be seen above it. Bottom left is the sensitivity pot.

GETTING YOUR AMATEUR LICENCE

The importance of Frequency Modulation is increasing every day, and will continue to do so since it is the method of modulation used for the sound channel of the proposed Australian television service. It is used extensively in communication work, and when properly adjusted has some very valuable features.

AMATEURS are expected to know something about FM, and it is highly probable that AOCP examination papers will feature questions about it as a regular thing.

These are liable to cover first of all an explanation of what FM is, as distinct from AM, the definition of standard terms relating to FM and their significance in understanding FM operation, and possibly some simple circuits illustrating how FM is achieved in practice.

You might also be asked about the advantages claimed for FM over AM, and perhaps its disadvantages as well. You won't be able to answer such questions without a pretty firm idea of how it works, which leads us back again to the need for a clear picture of fundamental theory.

FUNDAMENTALS

This is well covered in most of the textbooks suggested for study, but a summary of the main points is indicated in this series, and perhaps we might be able to present them in a more logical order, or even throw more light on the difficult places.

It is a good thing, however, to read over all the references to FM theory you can find, as each will have its own approach, and although the picture may be confused at first, little by little you will find the various points will fall into place.

The process of modulation means the impression on a radio carrier of a sound, sometimes in the form of a steady tone, but more generally speech. The amateur knows such transmissions as phone signals, although the correct term is radiotelephony.

It is brought about by causing the electrical currents from the microphone to operate audio amplifiers, which cause the characteristics of the carrier to vary at an audio rate.

DEMODULATOR

In a receiver, a suitable demodulator is provided which is able to convert these carrier characteristics into audio frequency currents, more or less duplicates of those produced by the microphone, and an audio amplifier which ultimately operates a pair of headphones or a loudspeaker.

These remarks apply equally to AM and FM, and will serve to provide a basis for common understanding and comparison.

Let us begin by imagining we have been asked the question, "What is Frequency Modulation and how does it differ from Amplitude Modulation?"

The system known as Amplitude Modulation causes the carrier wave to vary in amplitude at an audio rate. The louder the signals, the greater the variation in amplitude. The higher the pitch of the sound as measured in frequency, the higher the rate at which the amplitude of the carrier will change.

When the audio power fed to the transmitter causes the carrier to increase its peak power by four times, represented by an increase in RF amplifier peak voltage and current to twice its unmodulated value, the maximum amount of modulation is reached, and the carrier is said to be modulated 100 per cent.

This degree of modulation is independent of the modulating frequency, and can be reached using any audio tone or combination of tones as in voice or music.

The amount of modulation is called the Modulation Depth. The audio frequency at which modulation occurs is called the Modulating Frequency.

HIGH LEVEL MODULATION

In the interest of efficiency, modulation generally takes place in the final stage of the transmitter where the generated power is greatest. For 100 per cent modulation, the audio power required to operate the RF amplifier equals one-half the RF power. Modulation can be carried out in an earlier transmitter stage, but this method involves difficulties and is generally avoided.

In Frequency Modulation, the carrier wave is made to vary in frequency about a centre point at an audio rate, its amplitude remaining constant. The greater the amplitude of the modulating frequency, the greater will be the frequency variation of the carrier.

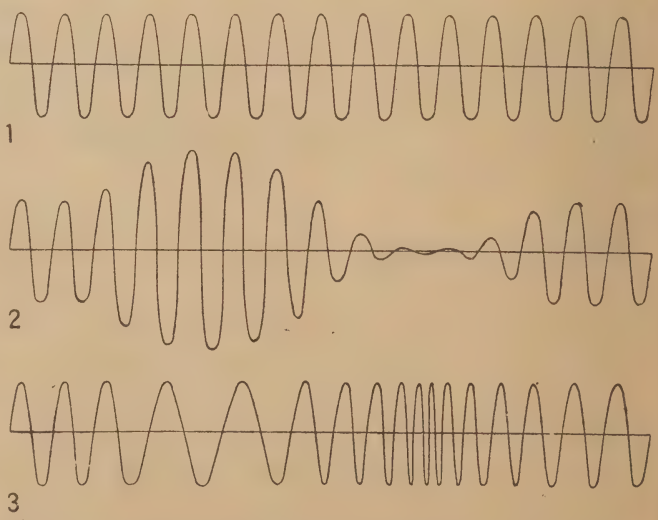
The rate at which this variation takes place is equal to the frequency of the audio signals used for modulation.

This is the initial conception which must be mastered before proceeding any farther, and, although it appears a simple point, it confuses many beginners. We have used similar phraseology to describe both methods, because it is not hard to change one's thinking by first of all appreciating the difference between carrier amplitude and audio frequency on the one hand, and carrier frequency and audio frequency on the other.

There is, however, no direct parallel in FM terms with the 100 per cent modulation of AM. The amount of frequency variation in FM has theoretically no limit, although there is little point in carrying it to extremes, and receivers would be made impossibly difficult because they must have a bandwidth capable of passing the full FM bandwidth with good linearity.

RECEIVER FUNCTION

If this 100 per cent modulation conception is applied, it can only refer to the receiver rather than to the transmitter. If a receiver, for



Diagrammatical comparison between an AM and an FM wave. (1) is the unmodulated carrier, (2) the AM wave and (3) the FM wave.

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instance, is designed to operate with a transmitter which swings 5 Kc each side of its centre frequency, it will recover the greatest amount of audio with least distortion when the transmitter is limited to this amount. For highest efficiency, transmitters and receivers must be designed together in an FM system, as far as bandwidth is concerned.

There are some definitions which must next be mastered before proceeding to discuss FM transmission. Here, again, it is important to get these firmly fixed in one's mind, although their full importance will not always be realised until the system is treated in more detail.

Carrier swing is a term sometimes applied to the total movement in frequency of an FM transmitter. If this movement is equal to 5 Kc on each side of the centre frequency, then the carrier swing is 10 Kc. The centre frequency is sometimes called the resting frequency.

Deviation is the amount of carrier frequency change from the centre frequency as a result of modulation. As we have seen, it is in true FM proportional to the amplitude of the modulating signal, but independent of audio frequency. In the example given above, a movement of 5 Kc each side of the centre is equal to a total swing of 10 Kc, but the frequency deviation to each side is only 5 Kc.

MODULATION INDEX

The Modulation Index is the simple relationship between the deviation and the audio frequency of the modulation signal. In our example, in which the deviation is 5 Kc, let us imagine we have a modulating frequency of 1 Kc. The modulation index would then be 5, which is the ratio between the two. Naturally, the two frequencies must be expressed in the same units, which are generally kilocycles.

The Deviation Ratio is a variation of the Modulation Index, but it refers to the ratio of highest audio frequency to be transmitted in any FM system to the maximum peak deviation of the carrier. In voice communication, we often find an audio limit of 5 Kc and a peak deviation of 15 Kc, representing a likely maximum amount allowed by the system. The deviation ratio in this case would be 3, or 15 divided by 5.

For high fidelity broadcasting, the upper audio limit is often set at 15 Kc and the peak deviation at 75 Kc. The deviation ratio here would be 5, the result of 75 divided by 15.

The deviation ratio, therefore, is quite an important characteristic in designing the limits of an FM system for voice or music, which are both made up of many audio frequencies and complex wave forms. The modulation index would be used to express operating conditions of a single frequency inside the usable band for a deviation up to the maximum limit, when considering what goes on at some intermediate operating position within the transmitter's limits of deviation and audio modulation frequencies.

PHASE MODULATION

So far we have been talking about true FM, which implies a type of modulation which varies the frequency of the transmitter at its source of power—in other words, it frequency-modulates the oscillator.

There is a variation known as Phase Modulation which is applied to an early amplifier stage and which obtains a frequency modulations effect by varying the time-phase of the RF current in that stage.

Its advantage over FM is that whereas FM requires a self-excited oscillator whose frequency may be varied by changing the capacitance of the frequency - determining circuit, PM allows a stable crystal oscillator to be used.

It is therefore a simpler method as it is not easy to provide good FM without some method of stabilising the centre frequency. It is true that the frequency of a crystal oscillator can be varied by changing the capacitance across the crystal, but the amount of variation is very small, and many stages of frequency multiplication are therefore needed to provide a useful deviation at the operating frequency. This point will be elaborated later on when describing methods of obtaining FM.

To understand PM it is necessary to realise that during the process of FM the carrier frequency is alternately speeded up and slowed down during the process of modulation. This effect can also be produced by changing the time-phase of the RF current during each cycle.

In fact, a change in carrier frequency during FM is the same thing as a change in the time-phase of the RF currents, because when the modulating frequency is speeded up, for instance, more oscillations take place in a given time.

COMPENSATION

Because the receiving equipment uses circuits in the demodulator which are sensitive to frequency or time-phase changes, it doesn't matter in essentials whether we produce FM by varying the frequency directly in the RF oscillator circuit or by varying the time-phase in an amplifier circuit.

In fact, there is only one important difference in the result which is somewhat difficult to account for in simple language. With FM, the frequency deviation is proportional only to the strength or amplitude of the modulating signal, but in PM it is proportional to both the amplitude and frequency.

With PM, a high modulating frequency will therefore give a larger amount of deviation than will a lower frequency of the same amplitude.

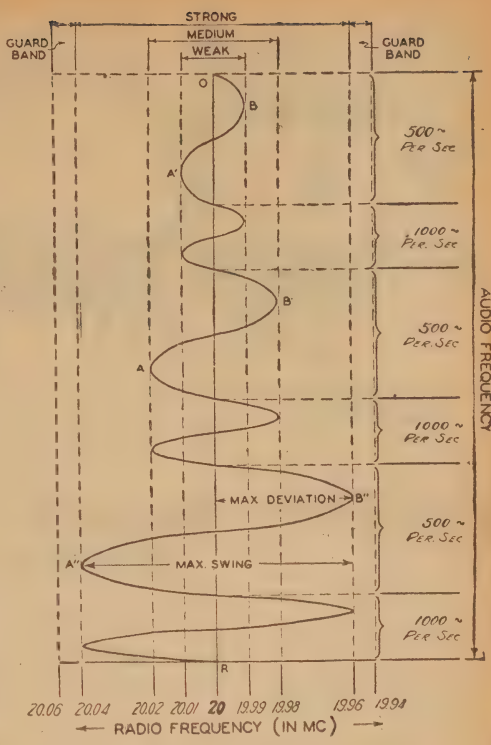
But with FM, the modulator merely changes the electrical value of capacitance across the oscillator tuned circuit. This change is brought about only by the varying amplitude of the modulating signal, irrespective of the audio frequency or frequencies involved.

Thus it follows that PM will, unless properly compensated, sound high-pitched and edgy as compared with FM or AM, and it is usual to include a high-frequency "roll-off" just as in an amplifier for use with pre-emphasised LP records. In fact, the process is called "de-emphasis". Its aim is to provide an even audio response and to limit the large amounts of deviation which could otherwise take place at the higher frequencies.

In amateur work, de-emphasis usually takes place in the transmitter to avoid using a wider bandwidth than necessary during transmission. In the case of high-fidelity broadcasting it is more usual to de-emphasise in the receiver.

AM VERSUS FM

The second half of the question we asked ourselves was: "What are the differences between AM and FM?" There are quite a few of these, but the examiner will be interested in the important points to see



This diagram illustrated the nature of an FM carrier wave modulated at two different frequencies at different amplitudes.

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TYPE 931-8: 20 watts.
Prim.: As 931-15.
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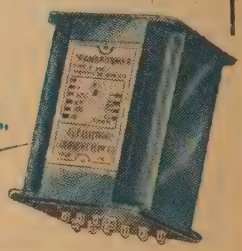
Resp.: As 931-15.
Valves: As 931-15.

TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60000 cps.
Valves: 807, KT66, etc.

TYPE 921-8: 20 watts.
Prim.: As 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As 921-15.

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50000 cps.
Valves: 6BW6, 6V6, KT61, etc.

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp. As 916-15.
Valves: As 916-15.



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LOOK FOR THE SILVER-GREY TRANSFORMER

whether you have grasped the theory behind them.

Many of these differences have already been included in the discussion so far, but we will list them again as a summary.

1. Amplitude modulation is usually carried out in the final transmitter stage, and requires an audio amplifier with an output power equal to half the RF input power for 100 per cent modulation.

Frequency modulation is carried out at the oscillator, or, in the case of Phase Modulation, in an early, low-powered stage, and requires only a small audio amplifier.

POWER HANDLING

2. Because the AM class-C output stage handles the extra voltage and current supplied by the modulator, it must be operated at reduced ratings for this service.

In an FM transmitter the voltage and current of the final stage are not affected by modulation, and the valve or valves can be operated at their highest RF rating.

3. Because of the deviation required for FM, which varies up to 75 Kc for high fidelity broadcasting, it requires a much wider bandwidth and therefore occupies more space in the ether. Receivers must be designed with IF bandwidths wide enough to accept the full deviation without loss of linearity. However, narrow band FM can be used for voice communication having a deviation little wider than required for the maximum speech frequency, or about 3 Kc.

AM bandwidth is directly proportional to the highest modulating frequency used, or a total of 30 Kc if the upper limit is 15 Kc as in wide range broadcasting.

4. FM requires comparatively complicated receivers of high gain and which are somewhat difficult to adjust. Recent technical advances are improving this position.

AM can be received with comparatively simple circuits which are very easy to adjust.

5. FM receivers, because they respond only to variations in carrier frequency, can be fitted with effective and distortionless limiting circuits which, under certain conditions, can render them insensitive to electrical interference and static. Under difficult conditions these can be more effective than those used with AM.

AM receivers can also be fitted with effective noise-limiting circuits, but these invariably cause some distortion to the received signals.

6. FM transmissions are very much less prone to cause interference to broadcast receivers than FM transmissions—quite an important point in amateur work.

DEVIATION

The modulation in FM is naturally applied to the oscillator circuit, and with PM it is generally applied soon after the oscillator and at the same frequency.

Not only is the required modulator power under these circumstances quite small, but the deviation it supplies may also be kept to a small amount which can easily be obtained.

This last point is quite important, and must always be considered when designing a transmitter circuit.

The deviation required for communication and broadcasting ranges from about 5 Kc to 75 Kc. It is not practicable to swing a carrier as much as this at the fundamental frequency.

But if we apply the modulation to an earlier stage, followed by a string of frequency multipliers, the amount of deviation necessary at the modulator stage will be reduced in direct proportion to the order of multiplication.

If for instance we require a deviation of 5 Kc at the transmitting frequency, and we have an oscillator operating at only one-tenth of this frequency, then if the oscillator is modulated its deviation need be only 500 cycles.

EASY ON VHF

This isn't a matter of any difficulty when operating on the VHF because it is common practice to use a comparatively low frequency oscillator followed by multiplications of 6, 8, 12 or even 18 times.

Assuming an oscillator deviation of the same amount for each of these orders of multiplication, it is obvious for example that the transmitter using 18 times will end up with three times as much deviation as one using 6 times.

It also means that a transmitter operating on 3.5 Mc would need a very low frequency oscillator if its ultimate deviation is to be a reasonable amount.

In a multi-band transmitter, complications are therefore introduced if we are to obtain the required amount of deviation on the lower

(Continued on page 111.)

Let's Buy An Argument

Any thought I might have had, last month, of dismissing "Ultra-Linear" from these columns was dispelled by a letter to hand from a New Zealand reader. Whether or not we agree with it in detail, his comment is so interesting and pertinent that it demands consideration.

by Neville Williams

I SUGGEST that you read his letter, opposite, right now so that you'll know what I'm talking about. Read it carefully and try to understand the points he's getting at.

The letter has been trimmed slightly to conserve space, but the original sense of it has not in any way been interfered with.

Read it? Good!

Well, then, let's get on with the discussion.

Personally, I don't agree with the letter in detail, but its contents provide plenty of food for thought—and that's always a good thing.

LOADING EFFECTS

The letter was prompted, as you will probably realise, by some speculation in earlier issues about the input impedance of the "Ultra-Linear" type output stage and the possible loading effects it might impose upon a conventional type phase splitter.

It had already been suggested by someone else that the balance of the push-pull signal might be compromised, with a degrading effect on the ultimate performance of the amplifier.

Now N.C. comes to light with a theory that balance is not the real problem at all; that the phase splitter will remain balanced, all right, but at the expense of a diminishing feedback factor at higher frequencies —and of consequently higher distortion!

As an idea, this appears both logical and intriguing, and it certainly lines up in part with observations. The phase splitter does retain quite excellent balance right up into the supersonic range and, in this respect, is a better proposition than the currently favored cathode-coupled inverter.

But distortion at very high frequencies may be another story, as our correspondent suggests.

Where we first part company with him is where he tries to assess the magnitude of the various effects. It looks very much as though some of his figures have got tangled up.

Part way through the letter he refers to the signal voltage appearing on the screens of a typical push-pull Ultra-Linear output stage. Unless I'm much mistaken, his conclusion is that the peak audio volts on the screen is about equal to the peak audio volts on each plate — a figure of 230.

ACTUAL FIGURES

Further, that this very high instantaneous screen voltage has a gross effect on the dynamic characteristics of the valve.

Let's get this straight before we go any further.

If my maths serves me correctly, a power of 9 watts across a 6000 ohm primary would be equivalent to an RMS signal voltage of 232. (N.C.'s figure of 230 is near enough.)

Since the winding is centre-tapped and the tapping is at virtual earth, the signal voltage on each plate must obviously be 115 RMS. This is equivalent to 162 volts peak, which would represent a substantial excursion from the working point along each valve's portion of the load-line.

Now, since the screens are assumed to be tapped (in terms of impedance) 25 pc along the load, they would each connect to the mid-point on the respective halves of the primary winding.

Neglecting minor discrepancies, it follows that each screen must have applied to it one half the audio voltage present at the corresponding plate. This would amount to 58 volts RMS or 81 volts peak—a very different figure from the one quoted by N.C.

LIKELY VALUE

As we pointed out in an earlier issue, the presence of this half-voltage on the screen should produce a virtual input capacitance (due to Miller effect) approximately half that for a triode giving equivalent stage gain. A spot of "guesstimation" and a roundabout practical test set the figure at about 70 pF for a 6BW6.

Even allowing a margin for higher gain valves, it is difficult to visualise the 300pF suggested by our correspondent. I'm inclined to believe that it has been exaggerated along with his other figures.

Then I have the vague impression (which may not be justified) that N.C. is imputing to the valves some kind of input impedance other than Miller effect and determined by their mutual conductance. I find it hard to accept any such idea.

DOES PHASE SPLITTER DISTORT?

I read with interest "Let's Buy . . . " in the March, '55, issue.

To begin . . . Should we regard the operation of the split-load phase inverter to be unassailable simply because under normal circumstances its performance is adequate?

Consider the simplification shown in Fig. 2, p. 71. While agreeing with the factors mentioned, are we justified in saying that under more rigorous conditions its output/distortion ratio with regards to frequency is LINEAR—as distinct from BALANCED; and more particularly, in assuming that the dynamic load presented by an "Ultra-Linear" stage is similar to the conventional one?

In your article you say that there appears to be no valid reason for the poor performance of the phase-inverter. Tell me, then, what's un-natural about this cat I'm about to pull down from the ceiling.

GOOD ENGINEERING?

In good engineering practice, attention is given to maintaining the screen of a tetrode or power pentode at virtual earth potential, so that its virtue as an electrostatic shield is unimpaired; and at a stabilised value of applied voltage.

As an "Ultra-Linear" amplifier, the screen not only is isolated from earth but supplied with a signal of considerable magnitude in-phase with that on its grid.

For example, with 9 watts across a 6000-ohm anode-to-anode output transformer the a/v will be about 230 volts. Assuming the use of a 25 pc screen/anode impedance tap the a/v at the screen will be 230 volts also.

This differs in two important respects from the effect of faulty screen regulation in the conventional pentode, in that variation in the "U/L", being counterphase to the a/v appearing on the anode, produces a marked increase in the linear operation of the tube, and a decrease in its dynamic output impedance.

Secondly, this a/v is of polarity favorable toward increased tube transconductance at precisely the time when increased efficiency is desirable. With this on the credit side, what's on the reverse?

First the screen, being isolated from cathode, will cause an increase in the dynamic input capacitance by some factor, to at least twice normal.

Secondly, the said input impedance is controlled, among other factors, byt its transconductance. Screen-voltage variations of the magnitude shown will alter this appreciably and by a factor reasonably guessed as 2.

The point I wish to make is that there will be an appreciable increase in the dynamic loading presented to the driving stage by the "U/L" mode of operation, and further that this will vary according to the magnitude of the input or output voltage.

Probably 300 Pf would not be an excessive value for the usual run of small power tubes.

How will this reactive loading affect the phase-inverter? In the split-load type proportionate voltages can be expected across the anode and cathode load resistors, at sound frequencies, if the external loading is slight.

Toward the load coupled to the anode, the source impedance is not the ohmic value of the load resistor, but a considerably higher one due to the mode of feed-back. In the cathode circuit there is voltage feed-back and its effect is to reduce the effective impedance. And the significance?

Consider an application where the inverter immediately precedes the power stage. The phase inverter under discussion had equal load resistors of .05 megohm. A reasonable estimate for the anode impedance would be 0.1 meg. and for the cathode impedance .01 meg. With negligible loading there will be no difficulty in obtaining a large proportion of the maximum a/v: the feedback ratio is massive and the inherent distortion low.

If the dynamic input capacitance of the "U/L" is increased in the manner I have suggested, then its effective loading of 300 Pf at 10 Kc (plus the grid resistor) will approximate .05 meg. This, connected across a source impedance of .1 megohm will reduce the output voltage to one third of its normal value. In the cathode circuit, where the impedance is about one fifth that of its physical resistance, the effect of a similar loading is less.

We know in practice that using the split-load phase inverter balance MAY be regained. How? By arranging that the ratios of resistance to reactance in each leg are equal. If this is so, the inverter will reflect in its anode circuit the loss of degeneration created in the cathode circuit by its reactive load. This increase in a/v will be exactly that value required to compensate for the overall frequency loss sustained.

All of this agrees with the simple explanation offered around Fig. 2. The danger is, however, that from the simpler explanation the original concept of the virtues of the inverter are retained.

As I see it, we obtain balance at lower output levels by virtue of an available reserve of feedback and at higher levels by the dissipation of feed-back with consequent increase in distortion.

It is because this distortion is frequency-selective, that I asked my first question.

The second, suggested that in the "U/L" there were two factors which would increase the loading offered by the power tube . . . lessened internal shielding which should result in a fixed value of reactive loading, and which can be neutralised . . . for a given cost: and the other, that the screen a/v variation, by partly controlling the tube's transconductance, also varied its dynamic input impedance.

Now this variation MUST operate with opposite sign for the two tubes, and present an UNBALANCED reactive loading across each section. Under these conditions the feed-back loop not only cannot correct, but tends to increase the unbalance.

The magnitude of these effects, even if much less than I have suggested, are sufficient to indicate that another type of inverter would be preferable.

ANOTHER NAME

Now for your "Give it a name . . ." The description "Ultra-Linear" is normal for this addlepated world, and the suggested terms "divided-load" and "partial-triode, are not really adequate. If you are partial to the thought, women are 90 pc water.

The tube used, is wholly a tetrode or pentode, and the superiority of the "U/L" mode is associated directly with the use of such a tube exorcised by counter-phase injection of signal to the screen from a low impedance source.

The end-result is simply a linearised pentode, or tetrode; so having removed the screen-sinister from its escutcheon, why not call the mode of operation what honestly it is . . . "Linear Pentode" or "Linear Tetrode" operation.

Sincerely, N.C. (Wellington, NZ).

Transit time and similar effects do not intrude at the frequencies which concern us and, if we assume that the valves are not to be driven into grid current, then they cannot have any resistive input component other than the normal grid return resistor.

The net input impedance is therefore made up simply by this resistor and the effective input capacitance, whatever it happens to be.

Our correspondent further states that "the dynamic loading . . . will vary according to the magnitude of the input or output voltage".

I'm not too sure whether he means that this rather nebulous loading varies with the general signal level, or over each input cycle.

If he means the latter, then presumably, by "freezing" the circuit at a plate current peak, we should discover a different input impedance from what we would find at say a plate current trough.

No sir!

We can't vouch for those "nebulous" components but Miller effect certainly doesn't work that way.

Miller effect occurs because, adjacent to the grid, there happens to be another active electrode carrying a voltage which is a replica of the input signal. By reason of mutual capacitance, some of this voltage is transferred back to the grid.

Assuming a change in phase between grid and the second electrode,

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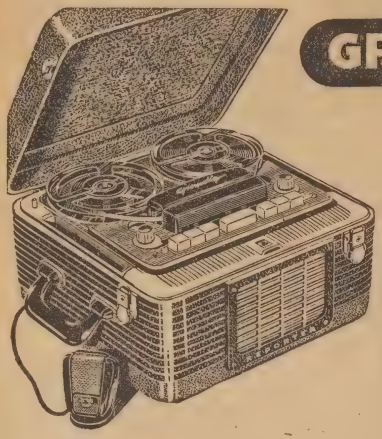

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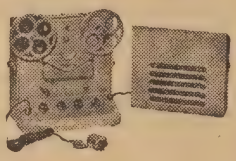

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he voltage feed back is predominantly negative in character. It loads he grid with a component which looks, to the signal circuit, like extra nput capacitance.

And because the voltage on the second electrode is normally greater han the voltage on the grid, the apparent capacitance is multiplied by whatever gain exists between the wo electrodes.

It is important to note that the word "gain" does not refer to any instantaneous quantity but rather the factor by which the output signal exceeds the input signal. We can measure it practically or calculate it by using parameters, of which the transconductance is only one.

DEFINITE VALUE

In a linear stage, which we surely must assume, the gain is independent of either instantaneous or average signal level. So also is the feedback path and the shunt loading it imposes.

For all practical purposes, the Miller effect input capacitance is as tangible and inert as a component soldered between grid and cathode, signed and sealed with a manufacturer's name.

I can't see, therefore, any justification for fears of what might happen as the said capacitance varies over the input cycle or with average signal level — if N.C. means that. Unless I'm very much mistaken, it doesn't do either.

Each output valve simply loads its own half of the circuit with a certain virtual capacitance, signals or levels nothwithstanding.

In fact, when you come to think of it, Miller effect loading must be substantially the same for both output valves, irrespective of their individual values of transconductance.

Why? Because an exact balance of signal voltage will be (or should be) maintained on plates and screens by the output transformer, so that grid-screen-plate gain will be the same for both valves. If the internal capacitances are reasonably balanced, so also must be the Miller effect.

So there it is: If Miller effect is going to cause trouble at all, by loading the two halves of a phase splitter, it will have to do it as a fixed value.

And, as we said earlier, if we prove that it is troublesome with the "Ultra-Linear" connection, then we'll have to watch triode output stages as well, because they could present even greater problems, using high-gain valves.

DOES IT MATTER?

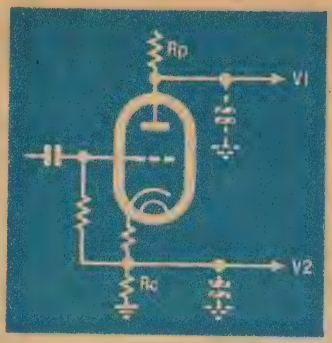
It yet remains to be demonstrated that Miller effect does, in fact, assume damaging proportions in practical high grade amplifiers.

Then our correspondent has some rather dubious things to say about screens and the potentials which appear thereon.

For example, I can't agree with his general statement that it is "good engineering practice" to maintain a screen at virtual earth potential and fed from a stabilised source.

It all depends . . . .

The screen usually has to be maintained at virtual earth in RF service to preserve stability. In audio service, however, stability is often improved by doing the very opposite;



The familiar and much-discussed phase splitter. A correspondent suggests that shunt capacitance, while not disturbing balance, does reduce degeneration at high frequencies allowing the distortion content to rise.

by tying the screen to plate, thereby lowering the gain, or by deliberately letting the screen float at the end of a "stopper"!

Then again, there are cases where a non-stabilised screen potential is an advantage. This probably isn't any news to N.C., but I make the point to emphasise that we have no fundamental or traditional obligations to the screen.

NO OBLIGATION

Rather is it "good engineering practice" to use it in any way which best meets our requirements.

If it involves tapping the screen into the load or letting it "float" at the end of a supply resistor . . . so what? It isn't prima facie evidence that the circuit is a bad one.

Then, our correspondent claims in two places in his letter that the screen in an Ultra-Linear stage is supplied with a signal which is in-phase with that on the grid and out-of-phase with that on the plate. How he gets this idea, I can't imagine.

Each screen is linked securely to its own plate circuit and must follow the plate's excursions, whether it wants to or not. Since the plate voltage is 180 degrees displaced from the grid voltage, the same must be true of the screen.

The voltage on it must OPPOSE the influence of the grid. For example, when the grid runs to a negative peak, it tends to cut off the plate current. Simultaneously, however, the plate voltage rises and carries the screen with it. The extra screen voltage supports the flow of plate current and therefore opposes the efforts of the grid to cut it off.

On the positive-going signal pulse, just the reverse happens.

It is, in fact, very similar to what happens when a screen is allowed to float at the signal frequency.

SIGNAL PHASE

In this case, a negative signal pulse reduces the electron flow through the valve and lowers both the plate current and the screen current. The potentials on both electrodes rise IN PHASE with each other. Similarly, the potentials reduce during the positive-going signal pulse.

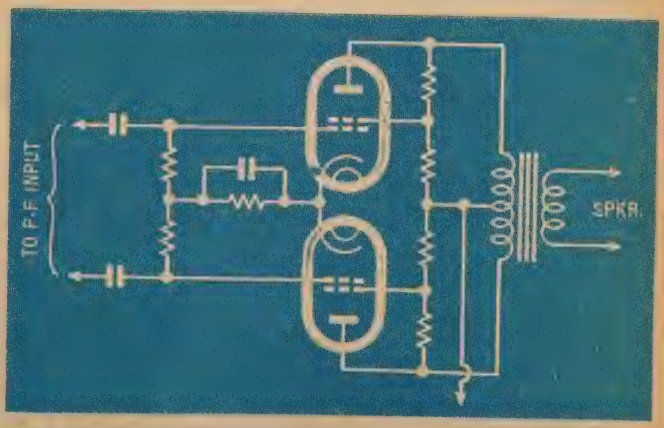
The difference between this and Ultra-Linear operation is not one of phase at all, because the phases are broadly the same.

The difference is that the screen is free to float in one case and will assume an instantaneous potential determined by the grid signal, by the geometry of the tube and by the load conditions in the plate circuit.

Thus, while a floating screen may follow the plate in a general kind of way, its variations may not be strictly proportional to the instantaneous plate potential.

In fact, if they were, we wouldn't have to go to so much trouble to achieve the "Ultra-Linear" effect. We'd simply let the screen float and be done with it.

(Continued on page 79.)



Feeding the screens from a divider network across the plate circuit appears to confer some benefit, though not nearly as effective as the original "Ultra-Linear" circuit.

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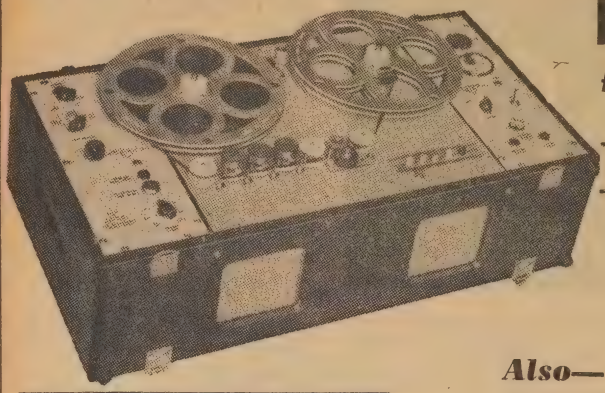

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We'll have more to say about this little later.

After all these brickbats, it might seemingly be hard to find reason for a bouquet but such is not the case.

Although we may have disagreed with N.C.'s preliminary assessments his remarks about the effect of capacitive loading on a phase splitter are both valid and original, as far as I know. I have certainly never seen the point raised in any of the numerous articles on phase inverters, nor have I heard it mentioned in equally numerous discourses on the subject.

In case you haven't quite got the point, have a look at figure 1, which shows the essential details of a conventional phase splitter. Resistors RP and Rc are equal loads, connected respectively in the plate and cathode circuits.

CATHODE FEEDBACK

As N.C. points out, there is a high degree of degeneration in the cathode circuit, which ensures low distortion under optimum conditions. However, it operates as voltage feedback on the cathode side and current feedback on the plate side, thereby lowering the circuit impedance feeding V2 and raising the impedance feeding V1.

Under non-critical conditions this is of no great consequence, the circuit remaining balanced as far as output voltage is concerned. And it will stay balanced, under a wide variety of load conditions, provided the loading on the two halves of the circuit is always symmetrical.

N.C. agrees with this but goes a step farther — and it may be an important step!

Consider the case, he suggests, where both sides of the circuit are shunted by a substantial capacitance imposed by the output valves.

At high signal frequencies, capacitive shunting on the high impedance plate circuit will tend to lower its output. However, the partial bypass on the cathode circuit due to similar shunting, reduces the degeneration and maintains the plate-side output at its former level.

In other words, the stage retains its balance with increasing frequency by a steady reduction in effective feed-back.

This could be expected to produce a rising distortion content, particularly where the stage is being pushed up toward its maximum output capacity.

DIMINISHNG LOAD

Considered from the viewpoint of load impedance, we may visualise the net plate and cathode load as steadily diminishing as the signal frequency rises. The AC loadline pivots on the working point, gradually approaching the vertical.

The output from the two sections of the circuit remains balanced, to be sure, but the distortion content rises as the loading becomes progressively more unfavorable and we continue to demand from the stage the same predetermined level of output signal.

A cathode-coupled phase inverter would show less reaction to such unfavorable loading, because the impedance of both output circuits is moderately low and reasonably balanced. Furthermore, each triode section has to energise one output valve only, whereas the phase splitter has to supply enough signal voltage to supply both output valves.

It's a nice bit of theory but one thing is lacking — namely a clear indication of the magnitude of the various effects.

N.C. has evolved a rather frightening set of figures but, I fear, on very dubious grounds. Perhaps, by the time they are reduced to more likely values, there won't be much to worry about, but it's an interesting thought, nevertheless!

In the final paragraph of his letter, N.C. discounts all previous suggestions about names for the "Ultra-Linear" circuit. His suggestions of "linear pentode" or "linear tetrode" aren't bad. In fact they're rather good!

Time alone will tell.

Just before closing the subject, I must confess to an absorbing curiosity about what would happen if the screens in a pentode or tetrode output stage were tapped into a divider strung between the plates and the output transformer centre-tap.

Would a linearising effect be achieved?

The attraction of the circuit is obvious. In that it avoids the need for a specially tapped output transformer.

DISADVANTAGES

The disadvantages are equally obvious. There must be some voltage drop across the screen supply resistors, although they are virtually in parallel as far as DC is concerned. The resistance values cannot be made too low, in an effort to avoid the drop, because they load the output circuit and dissipate audio power.

However, since the proof of the pudding is generally conceded to be in the eating thereof, I did take a few minutes off the other day to hook up a circuit along the lines shown in the accompanying diagram. A couple of 15,000-ohm resistors were used between plates and screens and 10,000 ohms from screens to centre-tap.

Since it was not possible at the time to take detailed distortion measurements, I had to be content with an observation of output impedance (without other feedback applied) on the assumption that reduced output impedance would automatically be reflected as an improvement in other directions.

There is an immediate trap for the unwary, here, in that the very presence of the screen supply resistors, shunting the primary, is sufficient to lower the output power and the measured output impedance.

I got over this difficulty by leaving the resistors in place and returning the screens to B-plus, plate or the tapping point, thereby changing from pentode to triode and to partial-triode operation. Then, by running the screens to the original transformer tappings and leaving everything else unchanged, direct comparison could be made with the normal ultra-linear circuit.

TEST RESULTS

As we expected, there was very little to choose between the output impedance of pure triodes and the ultra-linear arrangement, while the impedance of the pentode circuit was way up the curve on its own.

The arrangement using a resistive divider to supply the screens seemed to fall about half-way between the two, indicating that the partial triode effect was indeed present, but possibly countered by the tendency of the screens to "float" somewhat at their own dictation.

If one could draw any conclusions at all from such a rough and ready observation, they would be as follows:

(1) A resistive divider system supplying the screens does not offer the same degree of benefit as a properly tapped output transformer.

(2) Where an untapped transformer has to be used, as in an existing P-P pentode amplifier, some improvement in performance at medium power may be obtainable by supplying the screens as indicated. Peak power will be reduced, however, by the loss of screen voltage and by the shunting across the primary.

(3) The circuit might have a special appeal where ratings and conditions allow the plate voltage to be raised above that applied to the screen—again assuming that a tapped transformer is not available.

More than that I'm not prepared to say at the moment.

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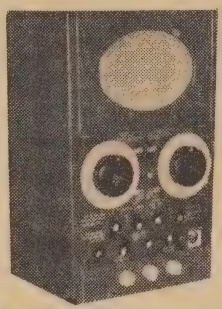

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GENEMOTORS

Input	Output			
24V	250V 100MA	£1	0	0
24V	550V 375MA	2	0	0
24V	300V 250MA	1	0	0
24V	250V 60MA	1	5	0
12V	270V 100MA	3	15	0
12V	500V 500MA	8	10	0
12V	1200V 200MA	6	10	0
6V	500V 150MA	6	10	0

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A SIMPLE ELECTRONIC LIGHT-SWITCHING UNIT

Here is a circuit submitted by Mr. A. D. Patch 112 South St., Rydalmere, which will appeal to those of our readers who wish to switch on and off lighting systems used for display or other purposes.

THIS unit uses standard, easily-obtained components. They may be mounted on a small chassis, preferably fitted with a protective cover to exclude dust and to avoid accidental contact with the relay connections.

The main advantage of having the unit on a separate chassis is that it is portable and more readily accessible for maintenance. An old receiver which is no longer used, but in which the power supply is still satisfactory could be modified to construct this switching unit.

Basically the circuit employs a conventional valve rectifier supply feeding a 6V6 (or similar type) output power valve, fitted with a relay in its anode circuit.

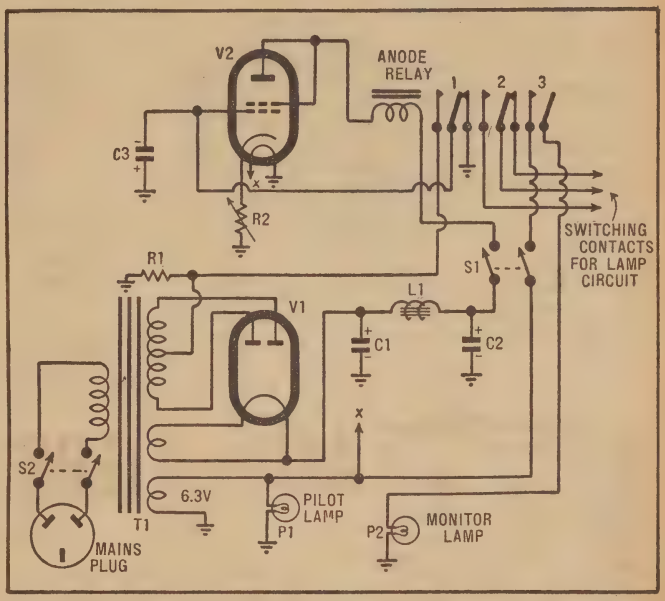
The main mechanical work involved will be in the mounting of the telephone type relay. As there are many types available the constructor will need to make a bracket to suit the particular one used.

If a receiver power supply is being modified to construct the unit, any voltage divider which is in it should be disconnected, as it will upset the operation of the unit due to the steady bleed current passing through the back-bias resistor.

Our contributor gives the following description of the operation of the unit.

When the mains switch S2 is closed, the power transformer T1 is energised and supplies the rectifier valve VI at the same time lighting the pilot lamp P1 from the 6.3 volt secondary.

With the switch S1 open, the DC output of V1 and the filter (L1, C1, C2) is not yet applied to the relay operating valve V2, nor is the 6.3 volt line connected to the relay contact which operates the monitor pilot lamp P2 to indicate that the unit is operating.



Closing S1 now completes these circuits. When V2 conducts the relay in its anode circuit closes. The "make" contact set "1," connects the grid and grid capacitor C3 to the negative end of the back-bias resistor. C3 then begins to charge negatively toward the cut-off value for the valve.

The charge-time is dependent upon the values of C3 and resistive quantities in the circuit including the back-bias resistor. To attempt to increase this time by inserting additional resistance in series with C3 results in a sluggish action and causes the relay to chatter; occasionally it remains in a half-operated state. With the arrangement shown, the operation is positive and regular.

Before C3 charges up to the cut-off value of bias for V2, the relay releases and now allows C3 to discharge to earth via the "break" contact "1" of the relay. A small series limiting resistor may be inserted in this lead if desired to limit the discharge current through the relay contacts.

The other contact sets on the relay make and break the external circuits as required, while the single third set operates the monitor pilot.

PARTS LIST

C1, C2	8mfd, 500V, electrolytic capacitors.
C3	200 to 400 mfd, 12V, electrolytic capacitors.
L1	Small iron-cored filter choke.
Anode relay	1000-2000 ohm coil relay, fitted with at least two change-over contact sets and one "make" set.
R1	Back-bias resistor, 500 ohm adjustable wire-wound so that it can be set to suit the particular valve used.
R2	0-5000 ohm potentiometer.
S1	DPST switch, 240V, 1A.
S2	DPST switch, 240V, 1A.
T1	Power transformer.
V1	Rectifier valve type 5Y3, 6X4 etc.
V2	Out put valve, 6V6, 6AQ5 etc.

EXTENDED RANGE
ON THE
THREE SPEED
'NOVA' RECORDERS
(7½-3 3/4 and 1 7/8in.)

NUMBER PLACE-FINDER

Gives exact location of any spot on the tape anywhere on the full FOUR HOURS of recording.

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Please add postage.

ULTRALINEAR

O/P TRANSFORMERS for every type of valve and any impedance as specified. Also the famous Williamson and Leak O/P Transformers.
All these transformers carry a guarantee to be flat from a few cycles/sec well into the supersonic range of frequencies.
REWINDS of all types of coils and transformers and any type to your specification. Call, ring or write for quotation of your needs.

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KITSETS AND COMPLETELY BUILT-UP UNITS
NEW REDUCED PRICES ON VIBRATOR TYPES
GERMAN FLASH TUBES,
500 to 1000 volt, only £3/12/6

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THE NEW "PHONE-EFFICIENCER"

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ONLY .. .. 29 gns.
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The long awaited ATTACHMENT TO CONVERT ANY SILENT PROJECTOR into HOME SOUND MOVIES 8, 9½ and 16mm.

NOW AVAILABLE: The "FILMAG" attachment is utilising the driving Mechanism of the projector and no extra motor is required.

(a) Sound recording and play-back unit £52/10/-
(needs tape amplifier).
For 16mm £57/10/-

OR THE COMPLETE OUTFIT
FOR ONLY .. .. 99 gns
For 16mm .. .. 108 gns
Magnetic Heads for striped film .. .. £7/9/- each

Send us your Film for Magnetic Striping, 3d per foot (minimum 200 feet)

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NOTE: New Telephone numbers:
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Open Sat. morning and weekday nights.

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6/5

Please send without further obligation details of.....

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I enclose LARGE self-addressed envelope and 6d in stamps

TRADE REVIEWS AND RELEASES

A. W. VALVE CO. RELEASE NEW LOW-NOISE PENTODE

The current interest in high-gain gramophone amplifiers has highlighted the need for a low-noise valve for the preliminary stages. To meet this need, the Amalgamated Wireless Valve Co. has just released a new low-noise pentode, type 6BK8/Z729.

THE valve has been designed specifically for audio work and special precautions have been taken to eliminate noise arising from leakage paths, from uneven cathode emission, from heater modulation effects and such like.

The manufacturers claim that, with suitable design, valve hiss and hum can be reduced to an equivalent of 2uV and 1.5uV respectively, when referred to the grid and at bandwidth of 15Kc.

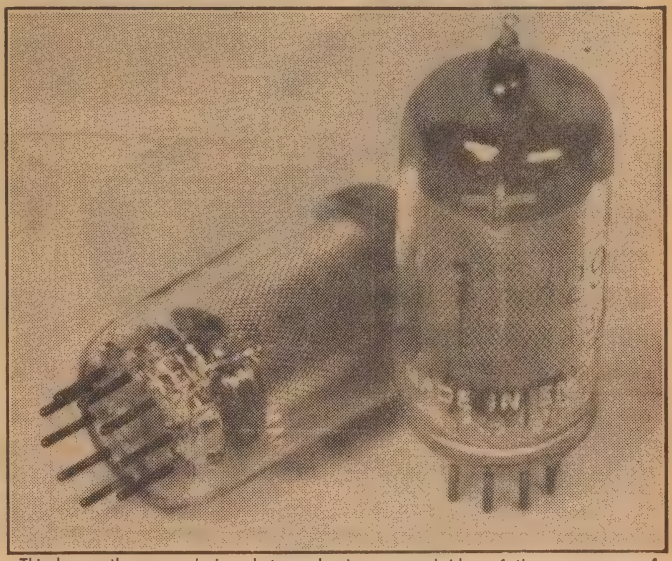
Lowest hum level is obtained when the heater circuit is centre-tapped and returned to a positive potential approximately 15 volts above the cathode.

Internally, the construction of the valve is rather unique. The element structure is rigidly assembled as a unit between top and bottom support micas, so that an absolute minimum of movement is possible between the respective elements.

However, instead of the structure being supported rigidly on the base and inside the envelope, it virtually "hangs" inside the envelope between the top points of the top mica. Leads from the elements to the base pins are light, flexible strips, intended to isolate the electrode structure as much as possible from distortion or vibration originating in the socket.

The anti-microphony characteristics of the valve are claimed to be adequate for all conditions normally regarded as "difficult" as in tape recorders, where circuits are subject to vibration from both motors and speaker. The use of anti-shock sockets may be advantageous, however, under extreme conditions.

The structure is shielded internally, the shielding being adequate for most purposes.

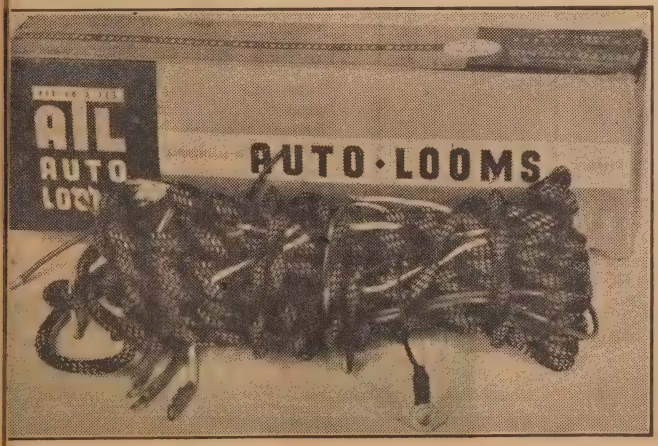


This larger than normal size photograph gives a good idea of the appearance of the new valve.

The 6BK8/Z729 is available immediately in quantity, the list price being quoted as 27/9.

It uses a 9-pin miniature base, has a 6.3 volt heater and a transconductance under typical conditions of 1850 umhos. Characteristics and application data are available from the A.W. Valve Co., 47 York St., Sydney.

REWIRE YOUR CAR WITH A READY-MADE LOOM



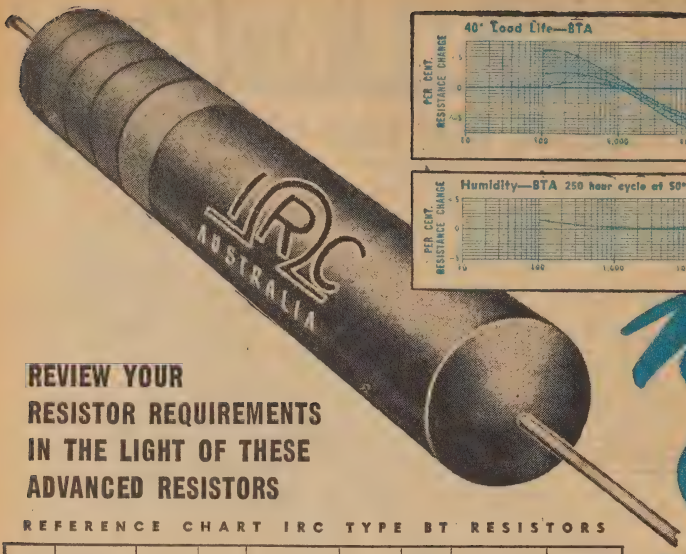
FROM Auto-Looms Pty. Ltd., we have received samples of some of the many cables which they are at present manufacturing for the automotive and electrical trades.

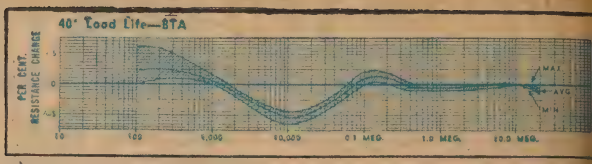
The samples include a large range of plastic covered cables, twisted, bonded, shielded, braided or protected by PVC sleeving. Auto-Looms say they are in a position to manufacture cables to special order finished in any of the above ways and containing conductors of selected gauge.

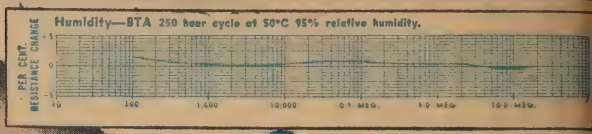
Of special interest to car owners are the complete wiring looms, as pictured on the left. These looms are available for all makes of cars and are ready for immediate installation.

The conductors are of varied and selected gauge for each circuit and are brought out and terminated ready for immediate attachment to terminals.

Normal supplies are through electrical or auto supply houses but inquiries may be directed to the manufacturers at Forest Lodge, Sydney NSW.







REVIEW YOUR RESISTOR REQUIREMENTS IN THE LIGHT OF THESE ADVANCED RESISTORS

New

IRC AUSTRALIA

MINIATURE TYPES

BTS & BTA RESISTORS

REFERENCE CHART IRC TYPE BT RESISTORS

IRC TYPE	RATING @ 40° C. AMBIENT	LENGTH	DIA-METER	LEAD LENGTH	LEAD DIA-METER	RATED VOLT-AGE	MINIMUM RESISTANCE	MAXIMUM RESISTANCE
BTS	½ watt	13/32"	⅛"	1½"±⅛"	.032"	350V	*82 ohms	22 meg.
BTA	1 watt	23/32"	¼"	1½"±⅛"	.040"	500V	*100 ohms	22 meg.

* Lower values under development.

obsolete all present standards!

STANDARD RESISTANCE VALUES FOR TYPE BTS & BTA
In accordance with RMA Resistance Values

RMA VALUE Add 0's for higher resistances	TOLERANCE 5%	10%	20%	OHMS 10 to 91	100 to 910	1,000 to 9,100	10,000 to 91,000	MEGOHMS 0.1 to 0.91	1.0 to 9.1	10 to 91
10	■	•	•	—	100	1,000	10,000	0.1	1.0	10.0
11†	■			—	110	1,100	11,000	0.11	1.1	11.0
12	•	●		—	120	1,200	12,000	0.12	1.2	12.0
13†	•			—	130	1,300	13,000	0.13	1.3	13.0
15	■	•	•	—	150	1,500	15,000	0.15	1.5	15.0
16†	■			—	160	1,600	16,000	0.16	1.6	16.0
18	■	●		—	180	1,800	18,000	0.18	1.8	18.0
20†	■			—	200	2,000	20,000	0.20	2.0	20.0
22	■	•	•	—	220	2,200	22,000	0.22	2.2	22.0
24†	■			—	240	2,400	24,000	0.24	2.4	—
27	■	●		—	270	2,700	27,000	0.27	2.7	—
30†	■			—	300	3,000	30,000	0.30	3.0	—
33	■	•	•	—	330	3,300	33,000	0.33	3.3	—
36†	■			—	360	3,600	36,000	0.36	3.6	—
39	■	●		—	390	3,900	39,000	0.39	3.9	—
43†	■			—	430	4,300	43 000	0.43	4.3	—
47	■	•	•	—	470	4,700	47,000	0.47	4.7	—
51†	■			—	510	5,100	51,000	0.51	5.1	—
56	■	●		—	560	5,600	56,000	0.56	5.6	—
62†	■			—	620	6,200	62,000	0.62	6.2	—
68	■	•	•	—	680	6,800	68,000	0.68	6.8	—
75†	■			—	750	7,500	75,000	0.75	7.5	—
82	•	•		82	820	8,200	82,000	0.82	8.2	—
91†	•			91	910	9,100	91,000	0.91	9.1	—

* Shows values available in tolerances indicated.
† 5% values only; 10% & 20% values NOT available.

TOLERANCES: Available in ±5%, ±10% and ±20% tolerance . . . in accordance with RMA values.

PRICES: BTS, 9d; BTA, 1/-

Write or phone your supplier for full details

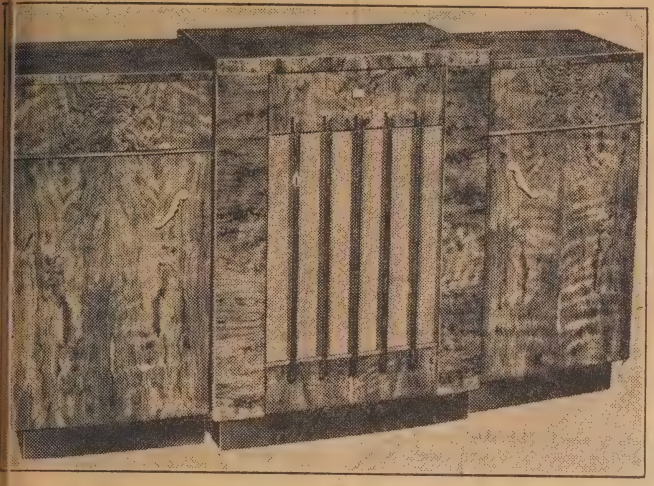
IRC miniaturised Type BT **insulated** Fixed Composition Resistors have set new performance standards which will affect your planning for years to come. Exhaustive tests by independent agencies have proved the superior performance of these resistors under actual field conditions, as well as in the testing laboratory. Check the graphs and tables carefully.

STANDARD RESISTANCE VALUE

Type BTS and BTA Resistors are supplied ONLY in RMA Resistance Ranges (Radio Manufacturers' Association), subject to minimum and maximum values for each type. These standard ranges are listed at left.

SOLE AGENTS FOR AUSTRALIA:
Wm. J. McLELLAN & Co
Pty. Ltd.
[illegible] SULLIVAN STREET SYDNEY [illegible]
[illegible] yards north of King Street

HIGH-FIDELITY EMI RADIOGRAM



Shown first at the recent Royal Easter Show, the new EMI model 91-45 True High-Fidelity Radiogram is soon to be released to the general public.

HE radiogram is in three separate units which can be placed ether to give one unit, as in the otograph, or separated to give ximum convenience of operation effectiveness of sound reproduction.

The main centre unit, which is vided with castors, is a vented closure housing a high quality le cone loudspeaker with high density magnet. The cabinet asures 27 x 18 x 38 inches.

The other two units are the rd storage cabinet and player upment cabinet, which contains, io tuner, pre-amplifier, power plifier, power supply and record yer. They each measure 18 x x 36½ inches.

The radio tuner unit provides in dition to the normal broadcast nd of 540-1600 Kc/s, three short-ve bandspread ranges. These er 5.9 to 7.5 mc/s, 9.4 to 12.1 /s, and 14.2 to 18.4 mc/s.

RIABLE SELECTIVITY

Variable selectivity is provided in s unit so that optimum results n be obtained from any particu- transmission The valve complent of the tuner is—6AN7 frency changer, 6N8 IF amplifier, nodulator and AVC, and 6AU6 out- cathode follower.

The pre-amplifier utilises the low se EF86 pentode as the input ge, followed by a 12AX7 equalr and cathode follower, and a ther 12AX7 for the steep cut filter d tone control circuits.

The pre-amplifier has six conls.

A five position equaliser giving acrate frequency compensation for basic recording curves.

A continuously variable volume ntrol.

A function switch selecting either dio, gramophone, or tape play-back sitions.

A three position scratch filter for minimising the surface noise on old recordings.

A continuously variable treble boost or cut control.

A continuously variable bass boost or cut control.

A low frequency cut filter is built into the unit to remove any turntable or recording rumble.

MAIN AMPLIFIER

The main amplifier is of the Williamson type having adequate power ouput for home listening with ample reserve to handle transients and high level passages. The valves used are 12AX7 voltage amplifier and phase splitter, 12AU7 push-pull driver and two triode connected KT66's in the output stage.

An automatic record changer is provided which may play records singularly in the "manual" position if desired. This changer will handle 7in to 10in and 12in recordings.

The pick-up arm is fitted with an American G.E. variable reluctance cartridge with diamond microgroove stylus and sapphire standard stylus.

The record cabinet contains ample shelves and partitions for record storage and the top portion of this cabinet under the lid may be used for housing records selected for a night's program from the main library below.

Provision is made in the storage cabinet to fit an "Emicorda" tape recorder which can be played through the tape replay position on the pre-amplifier.

In our last issue the telephone number of Special Transformers was given in their advertisement as XL4994. The correct number is XJ4994.

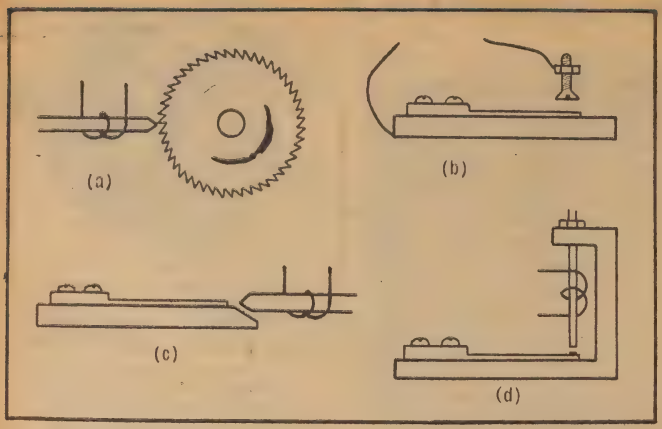


Figure 1: Illustrating (a) the principle of the tone wheel; (b) electrostatic pickup from metal reeds; (c) electro-magnetic pickup from steel or tipped reeds giving double frequency and (d) magnetic pickup at the fundamental frequency.

the same, each providing one draw bar for the fundamental and a num ber of additional drawbars for th harmonics.

The harmonics represented on th manuals are sub-fundamental su 3rd, 2nd, 3rd, 4th, 5th, 6th and 8t Each drawbar may be pulled out i up to eight positions; the farther ou it is drawn, the stronger will be th harmonic it controls in relation t the fundamental for which there i also a drawbar.

As an example, if only the funda mental drawbar is used, we get practically sinusoidal wave. How ever, in light of the foregoing dis cussion on additive synthesis, yo would rightly expect that if th second harmonic bar is withdrawn flute tone should result — and tha is just what happens. Likewise, an other tone may similarly be syn thesised, the Hammond Company is suing a comprehensive guide list t all purchasers.

SPECIAL BOOK

In view of the huge number o these instruments in existence ther has been published a book — "Dic tionary of Hammond Organ Stops

SURVEY OF ELECTRONIC MUSIC

Having discussed, last month, the nature of sound and the various means by which it can be synthesised, the author now goes on to discuss some typical commercial electronic instruments. He explains the various tone generating systems used, including tone wheels, reeds, optical patterns and valve oscillators.

PART 2 — SOME TYPICAL COMMERCIAL INSTRUMENTS

AND now the time has come to look at the first of these — the Hammond Organ.

This instrument was invented by Mr. Laurens Hammond and patented in the US as far back as 1934.

This organ, strangely enough, was never intended to imitate the conventional pipe organ and the manufacturers, when it was first marketed, stated that, whilst it could be played like a pipe organ, it was not to be taken as an imitation of it.

The naming of this ingenious instrument as an organ has been the cause of much displeasure among organ lovers. The fact of the matter is that the Hammond product, whilst capable of imitating many orchestral instruments and organ pipes, is, or was, "an entirely new musical instrument with a voice of its own."

THE CONSOLE

The console is quite familiar. There are two keyboards, or manuals, and also two octaves — or more — of bass pedals. In these respects the instrument is quite organ-like.

Volume, however may be controlled from a whisper to the full output of whatever amplifier is used. This dynamic range is vastly different from that available with the pipe organ and, since it covers the volume range of the latter instrument and more, may be described as adequate in this regard.

The Hammond Organ differs from all other instruments in that it does not have the conventional stop keys or tablets.

Church and cinema organs have stop tablets (some church and concert ones have drawbars) on which are marked the name of the pipe and the octave in which it will sound in relation to the organ generally. On registration of one, or more, of the tablets that "voice" will then be heard on depression of the playing keys on the manual to which it applies.

With the Hammond, there are nine drawbars applicable to each manual and a couple more for the pedals. Basically, all sets of drawbars on all Hammond Organs are

by R. A. B. Tarrant

—in which are listed 23 pages o reed combinations and hundreds o diapason tones! In fact, the manu facturers claim that, mathematically it is possible to have over 270 mil lion different combinations.

However, it is not possible to se up a mixture of say diapason, flut and vox humana on the one manua with the Hammond Organ.

Generally only one voice can b registered on one manual at a tim whereas, with a pipe and many othe electronic organs, it is possible t have all voices speaking at once This is regarded by pipe organist as one of the failings of the instru ment, the other being that the at tack is too sharp and not reali organ-like.

EXCELLENT INSTRUMENT

As long as there are two school of thought, these comparisons wil be argued over, but it can be state that the Hammond organ is a beau tiful instrument, mechanically soun and rugged, and capable of the mos delightful tones.

A brief word of explanation o the method of generating tones shoul be given before leaving this mos famous of all electronic organs. In common with the Mastersonic

d Robb Wave organs, it generates tones by electro-magnetic means.

In the case of the Hammond organ d Hammond spinet, each note of le instrument is a pure tone, taken om a low impedance coil wound ound a permanent magnet. At e end of the magnet, and very ose—but not touching—is a rotat- g disc, spinning edge-on to the agnet. This disc, or tone wheel, made of soft iron and has humps ounds its periphery.

As these humps spin past the agnet the flux is varied and an pulse generated in the coil. If 0 humps pass the pole in a second, en we have a 440 cps (middle A) ne.

Similarly, it is possible to cover a nge of several thousand cycles by rying the speeds and numbers raised portions on the tone wheels id thus, by gearing combined with n appropriate number of high ints—always a multiple of two—it possible to obtain a note exactly n pitch.

UNING PERMANENT

The whole generation assembly is iven by a synchronous motor and, nce every tone wheel is integrated ith every other one by gearing, it llows that the organ cannot get it of tune.

As a matter of fact, the Hammond gan is particularly robust and so ely engineered that mechanical oubles are practically non-existent, ven in prewar models.

The Robb Wave organ—due to r. Morse Robb—is a mass of heavy achinery and it is usual to instal in a basement, or a separate out ouse, from which leads to the con- le and amplifiers are brought.

On the other hand, the Master- nic organ—a line which is not nger in commercial production— not big, but is more bulky than ie Hammond generator. An inven- on of John D. Goodell and Ells- orth Swedien, this instrument was lmost perfect in its imitative quali- es, as regards the pipe organ.

It was unique in that the output f the generators was not a sine ave, but was a completely formed ne. This was accomplished by otation of a toothed wheel in front f a sahped pole piece, the actual naping determining the tone color. he use of a multiplicity of high- uality amplifiers and numerous peakers helped in obtaining the emarkable results of this very fine rgan.

VIBRATING REEDS

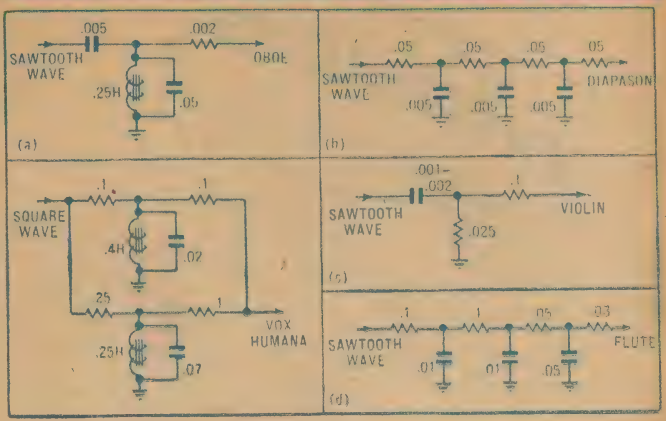
And now we turn to a completely ifferent type of tone generator—the ibrating reed.

This is a very popular method for he amateur constructor, because it s cheap and easy to get going. How- ver, the home builder will find that, vhen using parts from an old "pedal" rgan, the low notes all tend to ound somewhat "woolly" and the igh notes lack brilliance. This, too, as been the case with commercial nstruments.

The first of these, the Everett Orgatron, made its appearance round 1934, and was improved on rom time to time, thereafter.

In 1940 production was discontin-

TYPICAL TONE-FORMING FILTERS



Some typical tone forming circuits as used in subtractive tone synthesis to simulate: (a) Reed, (b) Diapason, (c) String, (d) Flute. The application of the Vox Humana effect is also shown.

ued, the manufacturers subsequently handing over the organ to the well known Rudolph Wurlitzer Company, who have since given up the manufacture of pipe organs to devote their full research and engineering facilities to the electronic variety.

Today, the Wurlitzer Electronic Organ is quite well known, and has reached a high stage of advancement, although the writer considers that it, in common with other reed generator types, still lacks brilliance and organ-like effect in the highest octaves.

Incidentally, a commercial electronic organ was produced in Australia, a couple of years back, its tone generating system being based on the same principle of vibrating reeds. A number of these instruments may be seen around this country but it is understood that the manufacturers, a widely-known radio concern, have now ceased its production.

The vibrating reed system may be either electrostatic as with Wurlitzers, or electromagnetic, in which case the reeds are of a ferric material, or are ferric coated, and vibrate in front of a magnet assembly and pick up coil.

There are two more cases of electrostatic pick-up having been used.

The first of these is in the British Compton Electrone, which uses spinning discs, engraved with the harmonic patterns of various types of pipes, giving a good range of diapason, flute, string and reed voices. Changes in capacitance between a rotating disc and a stationary one, placed close to each other, face to face, were handled like the output of a condenser microphone.

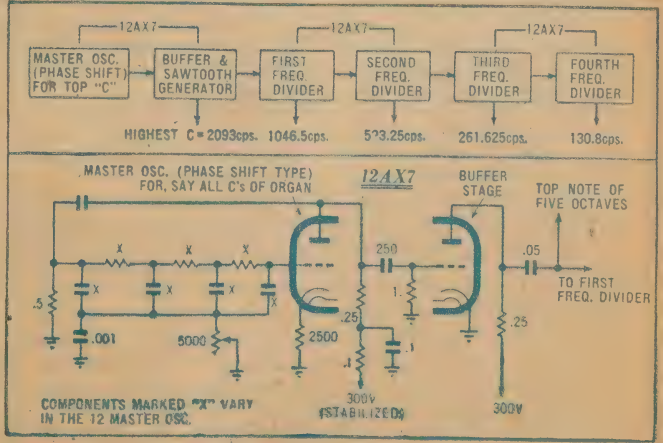


Figure 3: The tone generation system as used in the Minshall Organ. Valve oscillators provide the fundamental tones in the top octave, dividers reducing each frequency in 2 : 1 steps for the lower octaves. Details of an oscillator-buffer are also shown.

This instrument has a console lit to the specifications of the oyal College of Organists, but the ne generating apparatus is housed steel cabinets, on castors, some stance away. Also, there may be veral tone cabinets, with specialised ble and bass units.

The Compton Electrone was first aced on the market before World ar II, and, the invention of Mr. slie Bourn, is manufactured by e John Compton Organ Company d., of Great Britain. Many years work and research, resulting in me ingenious circuitry and techology, have brought the instrument its present state of general acptance by organists.

The other case of electrostatic ck up having been used was with e Minshall — Estey Organ, proction of which has been discontinued. The manufacturers are now voting their attentions to vacuum be generation of tones, resulting the instrument known as the inshall organ.

The Minshall-Estey Organ used eds as fundamental generators, ch reed being placed between the ates of a capacitor—a somewhat fferent application of the principle ed in the other reed organs we ve mentioned.

COUSTIC OUTPUT

In all cases of using reeds, their tual sound when actuated by a ind supply could not be heard irtually, because care was taken to nsure that their acoustic output as muffled by padding of the reed nest. The Minshall-Estey Organ as particularly effective in this reard.

Mention of the Rangertone will ast about close the field of comercial electronic organs based on lectromagnetic and electrostatic enerators.

This was one of the earliest of e electronic instruments and deived its tones from electrically conolled tuning forks — one for each emi-tone and tone of the octave. he inventor, an American, Major ichard H. Ranger, has been responsible for many other developents in this field, including neon amp generators but the Rangerne, though not now in production, eems to be the best known.

There are three other main ethods of tone generation — hoto-electric, neon tube and vacum tube.

Examples of the first are Ivan remeeff's "Photona", dating back to 1926 (the first electronic organ to be broadcast, 1933) the "Trillion Tone" and the "Welte Phototone".

This last, a German product, was marketed in 1936 and was very successful. Tones were generated by using the same principle as sound on film except that, instead of having a film, a rotating glass disc carrying the patterns of the tones of actual organ pipes, was used. Each organ utilised 12 such discs which rotated in front of photo electric cells, these being actuated by a light source passing through the wave patterns on to the face of the cell.

The production of this unique instrument halted because of the war, and has not as yet been renewed.

NEON OSCILLATORS

As for neon tube generators, these have been very thoroughly gone into and much success obtained, although it is significant that no commercial instrument makes use of them. There are innumerable patents covering developments of neon and gas tubes, yet manufacturers have not commercialised this method of generation.

In 1946, the writer heard a splendid three manual organ in England, which used 1200 of these tubes and the instrument performed very well indeed. Maybe more will be heard of these, yet.

By far the most comprehensive and varied system of tone generation emanates from oscillating tubes, and the names following are just a few of the major organ building firms: — Allen, A.W.B., Baldwin, Connsonata, Constant Martin, Hammond (their Chord Organ), Haygren, Jennings, Lincoln, Lowrey, Maestrovo, Minshall, Thomas.

We have already discussed additive synthesis and it can be stated here that it is not usually found in tube generator products.

Subtractive synthesis is far more common.

In this, a harmonically rich wave form is produced for each note of the organ, and the resulting tone is then passed through filters, of the type shown in the accompanying circuits. Certain portions of the frequency spectrum are boosted; others are cut out. Very accurate synthesis by the subtractive method is difficult and costly, but, in practice, the commercial firms obtain quite satisfactory results.

Some organs (Allen, Connsonata, Constant Martin, Haygren, and Thomas) use a separate tube for each note of the organ, which means that a two manual organ might well use up to 200 valves — a costly and bulky proposition.

FREQUENCY DIVISION

Others, however, get over this by resorting to frequency division, which in the case of three makes known to the writer, — Baldwin, Jennings and Minshall — give a good result, utilising fewer than 40 tubes in all.

SQUARE WAVES FROM SAWTOOTH

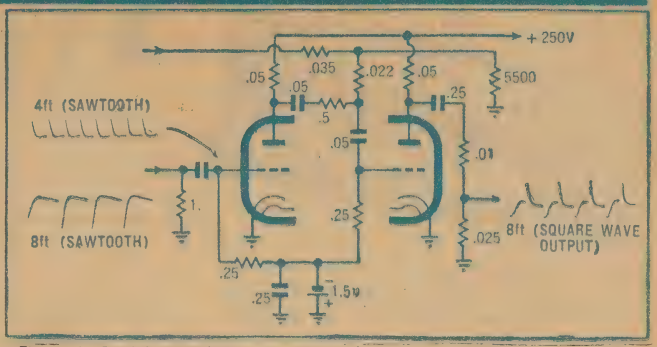


Figure A: Dr. W. E. Kick's ingenious "Outphaser system of forming a square type wave from two sawtooth waves from adjacent octaves—as used in the Baldwin organ. Square waves are used for "Hollow" sounding tones, such as clarinet, tuba, horn and bassoon.

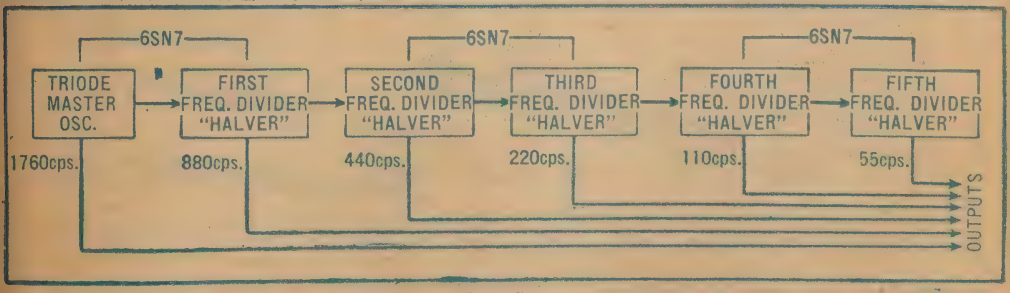


Figure 5: A block diagram of the frequency division, as used in the Baldwin organ. Generation of all A notes involves only three 6SN7 tubes, representing good economy in the overall number of valves required.

Frequency division implies the eneration of a pulse or sawtooth ave form, since a sine wave or quare wave will not "trip" a fre- uency divider.

The method invariably used is to enerate the twelve highest notes the organ and to feed these out- uts into frequency dividers. The utputs from the dividers are fed nto further dividers and so on, until he lowest note is arrived at.

A block diagram and circuit are hown for the Baldwin Organ which, nlike the others, uses specially ound transformers to obtain its re- ults. The big advantages of fre- uency division is that, providing the op notes are in tune, the subsequent otes stay in tune, too. The three ommercial instruments named all se frequency "halvers", although is possible, by changing some of he circuit constants to divide by hree, four or five and so on.

CIRCUIT DETAILS

This article is a survey of elec- onic musical instruments, and it is ot intended that circuitry should be one into. However there are a num- er of sources of further information or those interested.

Popular radio periodicals of over- eas origin carry numerous articles n the subject, there are a number f books — unfortunately not all eadily obtainable in Australia and lew Zealand — and quite a follow- ng who have carried their interests o the extent of building their own rgans, some with considerable suc- ess.

In addition, many overseas com- anies will send general literature n their products, although it is ard to get technical information rom them.

The Public Library of New South Vales has, at the request of the vriter, prepared a research on this ubject, and they have gone to a ot of trouble and care in the work. Vo doubt the Public Libraries of ther States have done, or will do, imilarly.

There is no fee for the service but t is suggested to anyone interested hat application be made for perusal f the works on a given date, since reading involves the opening and narking, in the case of Sydney, of ome sixty books and periodicals!

THE GENERAL PICTURE

Just where are we in the matter f elecrtonic music generally, and lectronic organs in particular?

Historically, we can go back to Dr. haddeus Cahill's Teleharmonium of 903, but the real and concerted ef- ort was not made until the early 930's.

In short we have, virtually in 25 ears, reached a stage where the roblems have all been resolved — n paper — and where the answer an now be supplied only by devel- pmental research and the ingenuity f the electronic musical engineer.

There is no doubt that electronic nusical instruments are here to stay nd will, no doubt, supplant the pipe rgan. Hundreds of thousands of lectronic musical instruments have een made and sold, and the output s going up year by year.

Capital invested in the USA is ver 10,000,000 dollars in plant for uilding electronic organs, and about 1,000 were built in 1953 — the lat- st figures to hand for that country.

(Continued on page 103)

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A Single Band Converter

(Continued from Page 51)

Coils are wound with 35 SWG amelled copper wire for the pri- aries and 20 B & S for the secon- ries. These are only approximate es and it would probably not ake much difference, if you used e gauge smaller or larger. Or- nary enamelled wire would do, hough cotton covered enamel wire the oscillator and RF primaries uld give better protection against eakdowns between windings.

The table below sets out the of turns required:

Aerial: Primary 2¼ turns inter- round with the earthy end of a turn secondary. RF: Primary 5¾ rns interwound with earthy end 7-turn secondary. Oscillator: condary 6¼ turns. The primary s 4¾ turns, with 1½ turns outside e padder end of secondary. The maining 3¼ turns are interwound. l coils are wound in the same rection.

Radar For The Blind

RADAR devices which will en- able the blind to "see" have been ported from time to time ever nce the war, but so far no one ems to have produced a practical uipment.

Possibly the allocation of fre- uencies has been a problem, al- ough it may not be necessary to e the radio spectrum to produce e necessary radiated waves. Supersonic sound" has big possi- lities.

However, there have been reports nce more that the "seeing eye" dog about to be supplanted by a mod- n electronic device.

From two parts of the world re- orts have been made of a new adar-like device which enables the lind to "see".

At Innsbruck, Austria, Professor heodor Erismann announced his ivention.

It hangs around the wearer's neck nd sends out sounds of rising in- ensity as the wearer approaches bstacles in his path.

At Topeka, Kansas, blind Mr. M. . McCollum, 45, has thrown away is cane and is "learning to walk all ver again" with a similar home- ade device.

Canaries Scorn Magnet Testing "Sixth" Sense

CANARIES, doves and parakeets sing and caper, scorning power- ul magnets placed in their cages to st a "sixth" sense, the Rev. John . Delaney, S.J., professor of physics, oyola College, Baltimore, MD., has eported.

Scientists at one time thought birds avigated during their migrations y using a magnetic sense. The hom- g instinct of pigeons was also be- eved to be connected with magnet- m.

Evidence for this theory after long esearch is neither consistent nor onclusive, Father Delaney said. His ests with song birds were made by lacing magnets in bird cages. The irds continued their play without ny reaction traceable to the mag- ets.

OFF THE RECORD — NEWS & REVIEWS

If you are looking for a recording of the Brahms Second Symphony which combines fine recording with a vital, full-bodied performance you need look no longer. Philips this month have come up with a record quite outstanding for both musical worth and technical excellence.

By JOHN MOYLE

IT is a clear-minded performance in which nothing lags, simply because both conductor and orchestra know exactly where and how everything should go.

This is one of the most popular of all symphonies, filled with melody and color and tenderness and exhilaration. All these are admirably handled in a disc of extreme clarity and force. It never fails under pressure, and I am sure it will leave you with that "lift", which is the mark of a first-class performance.

BRAHMS — Symphony No. 2 in D Major, Opus 73. Played by the Concertgebouw Orchestra, conducted by Eduard van Beinum. Philips AOO218L.

A magnificent recording—the best I have heard so far, judged on a total points score.

To be perfectly honest, I don't think any performance equals the sheer magnificence of the Toscanini record issued a couple of years ago. His Brahms records of that period were among the most successful discs he ever made, and he gave to the music a stature which was part of the magic he seemed to command. I am sure there are several passages in van Beinum's record which he would never have passed either technically or musically.

One of these which comes to mind is the strange moo-ing and wailing of trombones and bassoons in the second movement, which, probably through the forwardness of the recording, I found somewhat disconcerting. The smoothness with which Toscanini handles this movement is one of the finest things in it.

BETTER RECORDING

The recording of the Philips' disc is incomparably better than Toscanini's, particularly on good equipment. It has much more presence, and this has made the job of cohesion much harder than it would have been had more reverberation been used. Brahms needed a certain amount of this for his colors to completely mix, and the Toscanini record was well judged in this regard.

But the frequency range of the new disc is so much better, and as a result, the music so much brighter, that Toscanini's sounds dull and dated by comparison. The dynamic range also is greatly superior, and van Beinum achieves a climax, particularly in the last movement, which is unmatched by all but the very best modern recording.

And yet, except for one or two places of which I have given an example, the cohesion is very good. It is also a cleaner record than Toscanini's. The bass is fuller and with great weight despite a slight tendency to sound woolly at odd times.

Van Beinum's general approach can scarcely be faulted, nor can his timing. His handling of dynamics is quite superb, equally good in the lightness of the third movement as in the tremendous finale in the fourth. This last movement is tremendously vigorous and exciting, and I wouldn't change it in any particular, except perhaps to have asked for a stronger brass in the concluding bars, the necessity for which Toscanini saw with greater effect.

The surface is a good one, although the end of the second side has some very slight surface swish.

If I could have this disc as well as Toscanini's, I would be extremely happy, but if I had to choose, I am afraid van Beinum's effort would have to take first place.

MOZART—Concerto in E Flat Major, K449—Chopin and Liszt Recital. Played by Colin Horsely, pianist, with the Philharmonia Orchestra, conducted by Basil Cameron. HMV OCLP1012.

I found this record somewhat strange and disappointing. Strange because of the mixture of a Mozart concerto with various pieces by Chopin and Liszt on the other side, and disappointing because a promising young pianist didn't do better.

The Mozart is probably the best effort. It is played with great taste and extreme care, but with little imagination or maturity of judgment. It is pleasant enough to hear, but I could not stack it up against the work of a dozen others who might have taken his place.

The orchestral support is extremely good and crystal clear, but the sound lacks that certain amount of body which even an NAB curve with some bass supplementation could not supply. I could not therefore, rate it as being more than good average standard against which there are no serious black marks, but not enough credit points to make it out of the ordinary.

The recital on the reverse isn't nearly as successful. I just can't understand the pianist's approach to some of them such as the Dance of the Gnomes, while the lesser-known Chopin pieces did not hold my interest.

The piano tone is quite good, although somewhat remote. The surface is free from clicks but has a slight swish, which might be picked up by wide range machines.

J. S. BACH. Vol. 1 of complete organ works (10 pieces). Played by Anton Heiller on the organ in the Reformation Church of Thalwil. Philips A00205L—A00206L.

These are two mighty records. After several hours of listening to them, and others I had available for comparison, I reel toward the typewriter still amazed that so much can be placed on a mere disc without something giving away under the pressure, including myself.

As recordings, I have nothing better in my library, and only on some special custom-made types have I heard their superior.

This is a modern organ, built in 1946, and probably a high wind pressure type. It has enormous power and precision, and a formidable array of stops and combinations, a most interesting contrast with the lower pressure organ used by Schweitzer in his recently released discs, which cover the same ground. A further comparison can be made with the Baroque type used by Fritz Heitmann and Flor Peeters for Radiola and Nixa respectively, also reviewed during the last few months.

MODERN BACH

Here we have the full case for Bach played the modern way and in earlier style, as both Heiller and Schweitzer include the magnificent Toccata, Adagio and Fugue in C minor on the discs I have.

Schweitzer's slow tempo with Bach is part of his philosophy, and, indeed, it may have some roots in the fact that the older organs are unlikely to have responded with the same facility as with a fully modern action. Whether Bach himself would have taken advantage of the superior speed and power of the modern organ is a matter for discussion but Heiller does a magnificent job in giving us a demonstration. He is a young man of 32 who has already achieved great distinction in Europe, and he plays with great vitality and authority.

Schweitzer's performance as mentioned in its review does sound rather ponderous under its burden of scholarship, and one can almost hear him listening to every note and phrase. Heiller does not present such a careful analysis, but his structure is more magnificent and brilliant. Strange to say it is Schweitzer who plays the Adagio at the quickest tempo, and he brings from the music an atmosphere that the younger man, despite his beautiful playing, cannot match.

SUDDEN CHANGE

But, with the opening of the grave the recording has caught the sudden change to a new manual with an almost electrifying effect, which shows how far apart his approach is from that of Schweitzer. This work I think is the finest effort in the whole album.

There is enough on these discs to merit quite a bit of discussion but space and my lack of intimate experience with organs compels me to stop, with the strongest recommendation to hear this music for yourself, particularly if you are an organist. Apparently we are to re

ive the whole series from Heiller, d the remarkably fine program es give full informtaion about e organ, its registration, and the ps used throughout each item.

I would make special mention of e clarity of pedal notes. My big oofer separated them quite clean- even during some fast changes, though now and then their weight nded to overshadow the treble. n AES curve I found the best compensate for this, but in the ll organ passages I thought hweitzer's recording achieved a tter balance. This, of course, has uch to do with the characteristics the building and the microphone acement, as well as organ layout, r to place the mike too far away ould invite hopeless reverberation.

Even if you could hear it, there is no surface noise, nor a single bad te from start to finish.

RAVEL—Daphnis and Chloe Suites Nos. 1 and 2—Alborada del Gracioso. Played by the Orchestra National de la Radio-diffusion Francaise. Conducted by Andre Cluytens. Columbia 330CX1134.

Dahpnis and Chloe is probably avel's most impressive work, music or a ballet of gorgeous color and times striking power. The music so good that it has little trouble supporting itself as a symphonic uite, and this record presents it s such in two sections, frequently layed independently.

In fact, they are merely sections f the ballet lifted from the normal ontext, so arranged no doubt be- ause the whole thing is too long o present as a concert item.

The editing process may annoy hose who are familiar with the allet as such, but they won't of- nd the vast majority who have not een it, for they hold together quite atisfactorily.

COMPARISON

It is natural to compare this re- ord with the complete ballet as erformed by Ansermet on a Decca elease of some time ago. The ecca scores a point in that it gives he lot, but this new disc makes trong competition as a recording.

It is more forward than the ecca, and has, therefore, a more ntimate impact of which it makes he most.

Ansermet's orchestra has a more emote mike placement and has more f a concert atmosphere. At times his provides a more subtle sound, nd a wider palette on which the rankly exploited instrumental re- ources can spread themselves. The ew record was made in a theatre, nd the smaller chamber gives the ey to the contrast in the result.

With these differences, the musi- al worth is fairly equal. The ew record has less surface noise han the Decca, and its frequency nd dynamic range are admirable.

The Alborada del Gracioso is hrown in as a side filler, and is f the same general standard. This is a fine record.

MAX BRUCH—Violin Concerto No. 1 in G minor Opus 26; MOZART—Violin Concerto No. 1 in B Flat Major K207. Played by Tibor Varga and the Philharmonia Orchestra, conducted by Walter Susskind. Columbia 330SX1017.

I have never learned to love the Max Bruch concerto, and, although I'm not alone in this I know I will also be at odds with many who have, including a large number of violinists.

But to me its romanticism is manufactured and assumed; it does not strike with sincerity, it makes the listener feel somewhat embarrassed in being forced to listen to such adolescent protestations of emotion. In many ways it attempts to parallel the Mendelssohn, but it isn't in the same class.

Consequently it needs a violinist who is able to handle its shortcomings, and to add his own stature to a work which has very little of itself.

But my first impression on hearing Tibor Varga start up was that I had inadvertently left the turntable on the 45 speed.

FAST VIBRATO

He has the fastest and most obvious vibrato I have ever heard.

This, in concert with a sharp, shallow tone, failed in my view to infuse any real glow into Max Bruch. Again, this may be a matter of opinion, but in long sustained notes, an open string would be better than something that sounds like wow in the motor.

Otherwise this violinist plays well, and even with distinction, for his intonation is impeccable, and he draws his outlines with a decision which makes a much better job of the Mozart. His deadly vibrato, too, doesn't get a chance to obtrude itself so much in this second side.

Orchestrally, the record is very good standard stuff, and if you don't find Varga as annoying as I do, you will probably like it. But I think the Max Bruch has been done better than this.

BRAHMS — Serenade in A Major Opus 16. Played by the Concertgebouw Orchestra of Amsterdam conducted by Carlo Zecchi. Philips A00723.

The Serenade comes from the same period as the D minor piano concerto and in character is not unlike a Mozart Divertimento. The material and treatment, however, are less closely related to Mozart and Haydn as in the D major Serenade written about the same time.

This work was probably an experiment, for it contains no violins. Their place is largely occupied by the wood-wind, particularly the clarinet which Brahms used so effectively later on.

Musically it is very easy to hear but has no great depth emotionally or intellectually. Its general atmosphere is somewhat uneven. It echoes Brahms in many guises, and frequently achieves no more weight than a chamber music combination. On the other hand, in the last movement in particular, Brahms comes forward as a symphonist with much of his typical skill in orchestral development.

As a recording it is particularly successful. There are no great technical difficulties about it, and we get a very nicely balanced, smooth performance. The surface of my copy was virtually perfect, and there is no doubt the complete absence of clicks and swishes adds enormously to the enjoyment of work like this. The famous orchestra is in great form.

SPANISH MUSIC FOR GUITAR — Recital of 14 items by Narciso Yepes. Decca LXT2974.

We sometimes wonder whether double sided record of guitar mus or cello music isn't too much for o dose. This is probably a wrong wa of looking at it, for unless one we interested in the instrument concer ed, he wouldn't want the record an how. And if he is, he will. At ar rate, I found no trouble in listenir to this disc at one sitting and e joying every minute of it, despite t fact that before long it was evide that Yepes isn't the world's be executant.

But then this must be such devilishly difficult instrument to pl that perfection must be unusual.

At the same time, the technic blemishes didn't appear to be t result of the really hard parts, whic Yepes frequently rounds off in daz ling fashion. Rather are they oc notes missed out, and sometime more than odd ones. Here and the he has a trick of continuing h phrases without waiting for the coun and the purist may find this irrita ting.

But from there on, there is muc to delight the ear. Firstly the re cording is most realistic — there no difficulty at times in imaging th guitar in the room. Every variet of tonal effect is faithfully presente and it is astonishing just how muc of this there is to the guitar.

Most of the music is written fo the instrument, but a couple b Albeniz and Granados are arrange from the piano.

Unfortunately the surface has som minor blemishes which an EMI set ting will considerably reduce. The may not be present in all copies.

MOZART — Sonata in E flat major KV481 — Sonata in D Major KV306 for violin and Mozartpiano. Played by Nap de Klijn, violin and Alice Heksch, piano. Philips A00691R.

The Mozartpiano was one of th earliest piano forms which sound like a harpsichord in the lower regis ter and a piano in the upper.

This is probably because the low er strings were plain wires at lo tension as against the modern boun strings.

It is played with a hard techniqu similar to that of a harpsichord, an no doubt comes near to authenticity The violinist performs rather simi larly, and the net effect is one o precision rather than anything else

Recording technique is very clos — I wonder who it is we can hea breathing? But as both techniqu and intonation are very good, the ne effect is good also.

For authentic Mozart, part of th Philips Jubilee Edition, this disc i an interesting one. Recording an pressing are first class.

SCHUBERT—Symphony No. 9 in C Major. Played by the Halle Orchestra conducted by Sir John Barbirolli. HMV OALP1178.

This is an extremely beautifu record, and shares with Decca's ver sion with Joseph Krips as the bes performance of this symphony avail able here.

In my own opinion, it surpasses it, although they are both so good that it seems a hard thing to have to pit one against the other.

Barbirolli is an excellent conductor to choose for this work for it suits his temperament and musicianship exactly.

But the recording engineers and orchestra share equally with him in what success is achieved. I must except the man who looked after the pressing, for he has contributed the only real fly I can find in the ointment, or was it the man who mixed the "biscuit"? He has allowed a very faint swish to appear on each side, which isn't really bad, but enough to default on a five-star award.

On the other hand the Decca record has its share of clicks and so on, which infested some of the early Deccas, and perhaps the score evens out.

The main impression left of the new disc is balance. It is one of the best "concert hall" recordings I have heard in that the microphone is a little bit remote and the sound can be heard taking off among the rafters in a way which I think gives just the right texture to the music. I like it this way more than Decca's effort, where a closer mike placement has given more presence but less cohesion.

There is not the slightest muddiness or lack of clarity. Bass, woodwind, brass, strings—there is no loss or remoteness about them; only a perfect placement and definition when heard separately and a full orchestral blend when the orchestra plays as a whole.

Decca's approach on the other hand has greater presence and force, but it lacks the smoothness and charm of Barbirolli. Krips sounds pedantic against Barbirolli's wider sweep and broad drive.

Krips gets the better high frequency response as might be expected and does so well that I would not belittle his effort in my preference for the new disc.

In brief—could be a standard for some time to come. Does well with the EMI or NAB curve.

SIBELIUS—Symphony No. 2 in D Major. Played by the Halle Orchestra conducted by Sir John Barbirolli. HMV OALP1122.

This is another concert hall performance, and most of my general remarks in this regard about the Schubert 9th hold good. There is the same convincing, dispersal of sound, the same smooth quality, and the same distinguished playing.

But this is a symphony of great contrasts, where violence is encountered, and wild brass blazonings leap out to shock and shiver. There is no doubt that in these passages the Anthony Collins' record of Decca, which was so recently released, is the most impressive.

Once again it is the Decca which is the most forward recording, and its general amplitude is much higher. For sheer dramatic force one could not go beyond it, although as I mentioned at the time Collins is inclined to become theatrical at times.

Barbirolli's approach rather underlines this impression. One could not say that his performance lacked in vitality in any particular, but it does have more restraint.

He handles the second movement more the way I like to hear it. The music here isn't stark—it may be rough, but it has a great deal of heart, which must be shown if the performance is to strike home. I thought Barbirolli here was quite magnificent—some of the best Sibelius on records.

The HMV disc is smoother to play than the Decca. Once again it has a bit of a swish on the surface, but the Decca is by no means the quietest of pressings, and the stylus takes a bit of a beating on some of the fortissimos. So that, although it is the most impressive sound, it is also rougher than the HMV. Decca's frequency range is best.

So, that's it. If you wish to be swept away by impact, then you'll like the earlier Collins' disc. But Barbirolli's is a distinguished effort, and there is more music in it. His Halle orchestra must be among the best at the moment—it does some superb work, and, as you'll hear a few bars from the commencement of the third movement, can easily outdo the London Symphony in sheer viciousness of attack.

BEETHOVEN—Symphony No. 7 in A Major, Opus 92. Played by the Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG50022.

This is another Mercury which sounds best played at high volume in a large room. It is not without its own reverberation, but the pressure is so great at times that one needs to get away from it to appreciate the difference in decibels.

Otherwise it tends to sound more top and bottom than in the middle.

Two examples are found in the third and in the fourth movement.

In the third, the dynamic contrast is carried to the limit, the first section being brisk and lightly moulded, and the second played with all stops out, somewhat slow in tempo, but with great impact.

The last movement is given out with the utmost vigor, and achieves not only big sound but a big atmosphere as well.

The whole conception of the symphony is a display of all these things, vigorous and keen playing, full frequency range with the emphasis on the bass in loud passages, and brilliant performance. Because of this much musical light and shade are missing, and with a little more of it the performance would have been outstanding.

But it's a Mercury approach, and very different from orchestral recordings from some of the other studios, which, perhaps, have played safer. Whether they are more successful depends on your own point of view.

My main criticism is of some surface flaws which may not be in all pressings. Most of them are drowned by the heavy cutting, but a few bars at the start could have been quieter.

Intended for AES, but I found the EMI setting the best. But no extra bass, or you will find it overpowering on the second side, which is the better of the two.

DIXIE-LAND CONCERT by the Basin Street Six—Farewell Blues, When It's Sleepy Time Down South, Basin Street Stomp, Margie, Tin Roof Blues, Lazy River, What's A Plenty and Muskrat Ramble. Mercury MG25111.

A noiseless surface, extremely vivid recording, and star performance make this one of Mercury's best. Some of the numbers are

outstandingly good from a recording point of view, for instance the clar inet in Tin Roof Blues. The whol thing makes a first-rate Dixie-lan concert.

Recommended on all counts, par ticularly for Hi-fi fans.

IMAGES SONORE D'ESPAGNE — played by Angelillo de Valladolid and his Flamenco Group. Nixa LPY 120.

Flamenco music is the gipsy music of Southern Spain, and is rapidly gaining popularity overseas, where many recordings have been issued.

It is based upon one or two guitars, and a soprano or tenor voice in endless variations in minor key not unlike a Calypso in the genera idea. Other sounds frequently appear such as handclapping, the whole being strongly rhythmical performed with great gusto, and insidiously catching in its appeal.

This Nixa displays Flamenco in all its forms, with a recording stand ard which is first class. There is no surface noise at all, just a back ground of silence. Musically it is particularly interesting for it is built on the very primitive method of a vocal line supported by a limited use of harmonies.

As for the singing I could not help thinking that here was the original Johnny Ray with much the same unadorned emotional pull and aban don which holds good today. Maybe that's why Flamenco is having its fling, and the similarity is quite possibly a deliberate one.

That tremolo in the guitars, is it authentic? Or is it a slight tape wow?

SONG RECITAL OF SCHUBERT, BRAHMS, WOLF, FAURE, HAHN and CHAUSSON. By Mattiwilda Dobbs accompanied by Gerald Moore. Columbia 330CX1154.

The outstanding things about this record are firstly the beautiful re cording of Miss Dobbs's voice and secondly the remarkable freshness and purity of the voice itself—a springtime voice as a friend of mine described it.

If you like it—and it isn't very hard to like—you could listen to the record all day.

But if you are a connoisseur of lieder, then I doubt whether you would select her as the ideal inter preter. This goes, I fear, for most of it.

She is always completely charming, her diction is clear to a degree and she has obviously benefited from her voice training. But perhaps that's part of the trouble—she has not yet learned to include enough emotional variation in her singing. The net result is that if you weren't paying too much attention you might wonder when one song had ended and the next begun, so much similarity appears in the general character of her singing.

The voice as such is lovely to hear. It is extremely forward accentuating an intriguing sibilance as well as a somewhat explosive use of dynamics.

The surface noise is reasonably low and the recording extremely clean. Gerald Moore shares the honors without a doubt, not only as a musician but in the manner he has helped the singer.

J. C. BACH—Sinfonia in E Flat Major, Opus 18 No. 1, Sinfonia in D Major Opus 18 No. 4. Played by the Vienna Symphony Orchestra conducted by Paul Sacher. Philips ABR4005.

These two little symphonies are o completely charming, and they are played so beautifully that it is hard to find fault with them.

Those who associate the name of Bach with mighty sounds and weighty argument will get a shock if they are not already familiar with the very different kind of music written by the son of the great Johann Sebastian.

Johann Christian Bach was a favorite of his father who died when the lad was only 15, after which he travelled extensively, became organist at the cathedral of Milan, and ended up in England where he died in 1782.

Before doing so, he produced a good deal of music like this, most competently written with a technical imagination quite remarkable for his day.

In spirit, both symphonies are rather like the light-hearted works of Haydn and Mozart, and today's listeners will find them just as easy to hear, and just as eternally fresh. Their wit and gaiety are irresistible.

In my failure to find fault I include every aspect of the record.

First of all the orchestra, originally a small band of strings and woodwind, does not attempt to reinforce its ranks, and achieves a delightfully light and sensitive touch. Its playing is bright and full of interest.

The recording gives just the right amount of airiness and balance. There is nothing brilliant about the sound nor need there be. You wouldn't use it for a show piece, but you will play it often in relaxation and with pleasure.

And lastly, the surface is quite silent—even on wide range equipment it cannot be heard. What a difference this makes!

BEETHOVEN—Sonata No. 3 in E Flat Major, Opus 12, No. 3; Sonata No. 6 in A Major, Opus 30, No. 1. Played by Joseph Fuchs, violin, and Arthur Balsam, pianist. Festival-Decca CFR12-539.

The chief virtue of this record is a cleanly etched performance and recording to suit. The two performers are no strangers to Beethoven, and this is only one of a number of Beethoven sonatas they have recorded.

Their approach I thought rather more academic than warm, and these sonatas, although lacking in the intensity of some others, might have benefited had the players unbent just a little.

But they leave no room for uncertainty in what they have to say and in the way it is said.

The violin is more to the fore than the piano, although it was the pianist who showed the least austerity. But the whole thing has an excellent presence. The violin might come through best with a little top-note taming as its edge is occasionally noticeable.

My copy was not a perfect pressing, although in playing this showed only some surface swish on one side, which prevents it from getting a completely clean bill.

HE LIKES OUR ULTRA-LINEAR JOB!

Dear Sir,—The editor of a "Publication" such as yours, lays himself open to volleys of brickbats and an occasional bouquet. The latter probably makes up for the former and I am writing you to tender you a "beautiful corsage". You may, therefore, pick yourself a dandelion and put it in your buttonhole.

The reasons behind my kindly thoughts are that for many years past I have been toiling along in the wake of your amplifier designs and was, as I thought, irrevocably wedded to direct coupling and triode output valves, but I was intrigued by the blurbs that you not only uttered but put in "The Publication" about this so-called ultra-linear circuit. Your description of it as a partial triode circuit was probably the determining factor. Having provided myself with a big A and R output transformer I toilfully assembled the amplifier according to your circuit, taking the precaution, however, of doing this on a separate aluminium plate in case it did not work (as I had ma doots), I plugged it in and was not altogether disappointed at the sounds it passed on to my loud speaker.

I have now had this amplifier tested by experts and they allege that it is 1 db down at 20 cycles and it is within ½ db up at reference and the same to 50 kc. I have translated this jargon and believe it means, when coupled with the further allegations that the output is 17 watts at 20 cycles and 22 watts at 1000, that the amplifier is as good as can be expected and at least equal, if not superior, to any high cost imported jobs. I think I could reasonably say that you have cast your bread upon the waters to find it unexpectedly returned as cottage pudding, as I really mean the bouquet part. The A and R people have certainly turned out a magnificent job, which not only looks good, but is superb.

Many thanks, and try and think something for future issues as good.

Now for a small brickbat. I say "small" because, in any case, you will throw it back at me and I would not like to have to dodge a big one, while reasonably expecting to let a small one whizz by. To particularise, the FM tuner, I think, shows lack of imagination in being assembled on a chassis, which is not much better than a bread board. What I would like to have, is a combination FM-AM tuner in a compact form with, say a small AM tuner dial on the left, flanked on the right with a tuner indicator in the FM section, so that a decent looking front could be added and the whole thing be compact enough to slip easily into a cabinet. However, I suppose I shall make up the tuner and, after playing around with it a while, will redesign my own FM-AM on the lines I suggest. All the same, I think your present effort is quite creditable, in view of human frailty and other factors.—Yours, &c., O W.L M A.N.I.N (One who likes making a non-irritant noise).

FERGUSON PREFERRED TRANSFORMER RANGE

From Australia's largest range of Transformers we have pleasure in introducing to you a streamlined preferential listing of power, output transformers and chokes.
This new Ferguson policy of offering you a compact range has been implemented to give you, the consumer, whose demands have created it, the benefit of our knowledge of transformer requirements in modern day radio.

Our full productive capacity will be employed to ASSURE YOU OF IMMEDIATE DELIVERY of your Preferred Ferguson Transformer or Choke.
This list is designed to cover your normal requirements but remember our extensive range is still at your disposal.
Delivery detail of non-preferred types obtainable from your normal supplier.

FERGUSON'S NEW PREFERRED RANGE

POWER TRANSFORMERS FIRST PREFERENCE

CODE NO.	PRIMARY VOLTS	HTV Aside	HT MA	FILAMENTS
PF 130	230-240	285	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 130F	230-240	285	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 151	230-240	285	60	6.3V/2A 5V/2A
PF 151F	230-240	285	60	6.3V/2A 5V/2A
PF 152	230-240	285	125	6.3VCT/2A 6.3V/2A 5V/2A
PF 165	230-240	385	60	6.3V/2A 5V/2A
PF 170	230-240	285	80	6.3V/2A 6.3V/2A 5V/2A
PF 185	240	150	30	6.3V/2A
PF 201	240	225	50	6.3V/2A
PF 265	230-240	Secondary Volts		17 TAP 11.5, 10, 8.5/4.2A
PF 299	240	285	40	6.3V/2A 5V/2A

POWER TRANSFORMERS SECOND PREFERENCE

CODE NO.	PRIMARY VOLTS	HTV ASIDE	H.T. MA	FILAMENTS
PF 160	230-240	385	100	6.3V/2.5A 6.3V/2.5A 5V/2A
PF 164	230-240	325	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 166	230-240	325	60	6.3V/2A 5V/2A
PF 168	230-240	385	80	6.3V/2A 6.3V/2A 5V/2A
PF 169	230-240	325	80	6.3V/2A 6.3V/2A 5V/2A
PF 173	230-240	425	175	6.3VCT/3A 6.3V/2A 5V/2A
PF 174	230-240	285	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 175	230-240	385	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 545	240	Ext. 1000	2	6.3V/3A 6.3V/6A
		350	20	4V TAP 2.5/2A
PF 439	240	32V	60	240-32 STEPDOWN

POWER CHOKES FIRST PREFERENCE

CODE No.	HY IND.	D.C. RES.	D.C. MA
CF 102	15	300	60
CF 103	30	420	60
CF 105	15	250	80
CF 109	20	225	150
CF 196	20	130	125

POWER CHOKES SECOND PREFERENCE

CODE No.	HY IND.	D.C. RES.	DC MA
CF 106	12	200	100
CF 111	16	165	200
CF 112	10	70	250

If you have difficulty obtaining regular supplies, contact us immediately.

OUTPUT TRANSFORMERS FIRST PREFERENCE

CODE NO.	WATTS	PRIM Z	SEC. Z.	RESPONSE
OP 9	15	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 13	25	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 24	5	5000 SE	8.4 OR 2.1	30-15,000 C/S
OP 25	15	10,000 PP	15-3.7 OR 8.4-2.1	20-30,000 C/S
OP 44	10	5000-2500 SE	500, 250, 125	50-8000 C/S
OP 54	10	5000-2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 58	15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 63	15	10,000 PP	15, 3.75	30-15,000 C/S
OP 112	6	10,000 PP	2, 8 SUIT ROLA 12 OX	40-12,000 C/S
OP 113	6	5000 SE	2, 8	40-12,000 C/S
OP 118	6	8000 PP	2, 8	40-12,000 C/S

OUTPUT TRANSFORMERS SECOND PREFERENCE

CODE NO.	WATTS	PRIM Z	SEC. Z	RESPONSE
OP8M	15	10,000 PP	500, 250, 160, 125, 100, 83.5, 7.5, 62.5, 55, 50	50-8000 C/S
OP 17	32	10,000, 6600, 5000 PP	500, 250,125	50-8000 C/S
OP 19A	15	5000 PP	12.5, 8, 2.3	30-15,000 C/S
OP 65	15	10,000 PP	8.4, 2.1	30-15,000 C/S
OP 67	15	5000 PP	15, 6.5	20-30,000 C/S
OP117	6	5000 PP	8, 2	40-12,000 C/S
OP119	6	6600 PP	2, 8	40-12,000 C/S
OP 60	32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2, 2.7, 2.3, 2.	50-8000 C/S

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CODE NO.	PRIM VOLTS	D.C. VOLTS	O'PUT MA	BUFFER FULL SEC.
VT 104	6	250	60	.004
VT 210	12	250	60	.006

VIBRATOR TRANSFORMERS SECOND PREFERENCE

CODE NO.	PRIM VOLTS	D.C. VOLTS	O'PUT MA	BUFFER FULL SEC.
VT 116	24	250	60	.005
VT 208	6	250	60	.01
VT 209	12	250	60	.08
VT 211	32	250	60	.005 ea. half

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ENGINEERED TODAY FOR TOMORROW'S REQUIREMENTS

SPEED 'BATTLE' IS BATTLE NO LONGER

Despite the fact that there is now no longer any speculation on the matter of record speeds, there are still many genuine music lovers who have not caught up with the new look in recorded music.

THOSE of us who spend our time looking for new and specially good things to show off our new amplifiers may find this hard to believe, but I have come across two cases in the last few weeks.

Both have been men who, once as keen as the best, have been driven up with home building, or with jobs which sent them moving about, or other distracting things. In one unsuspected manner they have missed the full blast of LP records.

One had never even heard an LP. The other had heard some, played in indifferent equipment, and they didn't impress him as much better than in his very extensive library of 78's.

Both have now been subjected to the evening's treatment of some of the hot recordings we all know about, and are still walking in a bit of a daze.

One of them hasn't yet been able to come to the surface for long enough to make any plans. The other has had his amplifier rebuilt, has thrown out his old pick-up which he cherished with a tender hand, and has sworn off any more 78's in unmistakable language.

GOOD BASIS

Basically, both these men hadn't very far to go in equipment conversion. Their amplifiers were good ones—tube types needing only a pre-amplifier and some re-arrangement to make them do. One even had a two-speed motor he had never used. He also had two really good speakers, an Axiom 80 properly baffled and another American type of good but high quality.

All this time he has been obliging this gear to put up with a standard of reproduction which even for 78's wasn't good, even though once it might have passed muster.

He now knows that even if he doesn't buy another record, his new pick-up has brought new interest to his old ones.

The tragedy of all this is that both men have not been able to cash in on the better standard of records because they didn't know, and both have spent money on 78's which they ruefully admit need never have gone that way.

Isn't it time that the use of 78's in any form was actively discouraged?

This is almost true now in the USA, where 33 records for LP and 45 for others and pops, have an increasingly clear market.

IT'S MUST GO

It seems inevitable, now that satisfactory mediums are available for both types of records without using 78's, that sooner or later the odd speed must die.

It perpetuates the need for a dual pick-up, the records are in all cases much heavier and bulkier, and are more fragile. The best 78's are exceedingly good, but they can't universally be better than microgrooves.

Why not then make 78's as long as they are inevitable as a business proposition, but place such emphasis on microgrooves in sales campaigns, both for records and players, that the public just won't want them?

Maybe it's a little early yet for any more drastic action, but it is undeniable that the sooner we can get quit of the 78, the better for all concerned.

The position will right itself over a period of time by the steady replacement of old radiograms with new. But, as this process is on the way, why not accelerate it? When a new development in cars, or motor oil, or refrigerators comes about, the out-dated products aren't kept alive. The principle is the same although I know quite well that the issue isn't so clean cut.

PRODUCTION TROUBLES

For instance, 45's at the moment are more expensive to make than 78's, partly because of the raw material cost, and partly I suspect because of the production difficulties.

I don't think it's a secret to say that wastage on 45's is considerably higher than 78's. Moreover, overseas, the injection process is widely used for fast, large-scale pressing of pops, but it isn't so suitable or successful here at the moment.

The optional centre has probably not helped matters. It must be cut into the disc after manufacture, which again adds to the processing and handling costs.

It can't safely be ignored because it is not unlikely that the new RCA arrangement with Radiola might well include the production of the RCA type baby record changer with its large centre pillar. But if this changer did appear, it would no doubt accelerate the move to issue pops on 45's as against 78's.

All this is undoubtedly very true. But I can't help thinking of many others still sticking along with 78's who didn't know the score on microgroove.

Each one who becomes converted brings the day nearer when we can get along with two speeds instead of three. Let's help their conversion as quickly as possible.

ELECTRONIC MUSIC

(Continued from Page 93)

The writer knows of numerous French, German, Italian and Russian patents, and over 190 American and 140 British ones, with six major manufacturers in Great Britain and 15 in the United States.

The point of all this is that electronic music is a big thing and interest is widespread—the Electronic Musical Society of the United States numbering over 80,000 and a reliable estimate of the number of instruments in existence being 400,000.

With such an interest it is undeniable that electronics, as applied to music, is "going places".

Grandfather said with conviction that the car would not replace the horse and sulky. They laughed when today's TV was predicted, and the average pipe organ lover bristles at the effrontery of anyone comparing the King of Instruments with electronic ones — but kings come and go; don't they?

SHORT-WAVE NOTES BY ART CUSHEN

ELWA LIBERIA — OBX40 PERU TESTING

Test broadcasts from new 10,000 watt transmitters located in Monrovia Liberia and Lima Peru have been heard over the past month.

"THE Voice of West Africa" is the slogan used by the new Missionary broadcaster located at Monrovia, Liberia and using 11800 Kc. Announcements indicate that the station would appreciate reports on the broadcasts to Box 192 Monrovia. Listeners in North America are enjoying good reception at 3.00 am, but in this area severe interference is had from the BBC transmitter GWH also on 11800kc with the General Overseas Service to sign off at 6.15 am after which the reception of ELWA is possible but side interference is noted from Rome on 11810 Kc and Cologne using 11795 Kc.

ELWA is operated by the West African Broadcasting Association and also has a 1000w transmitter on broadcast band. Liberia will be a new country for our readers, as the Republic's only other station ELBC using 6022 Kc has at times been heard in this area, but the station is operated privately and the many requests to Dr. John B. West the station President have never been verified, some listeners in an attampt to verify this rare country made a request to the Liberian Government's London Representative who offered to try and get the President to co-operate but without success. Liberia on the north-west coast of Africa was settled by the US Government after the American Civil War when many of the Negroes were returned to form this new Republic.

RADIO EL SOL DEL PERU

Test broadcasts from a new 10,000 watt transmitter which has just been installed near Lima, have been received on 5970 Kc to closing at 1 am local time which is 4 pm AEST. Both English and Spanish announcements were made, between a program of recorded Spanish musical numbers.

The use of the frequency by H14T "La Voz de Dominicana" Ciudad Trujillo, Dominican Republic, OBX4Q, can therefore only be heard after 3 pm when H14T signs off. A suggestion has been made to the Lima station that they drop to 5965 Kc to avoid this interference, and that which is received from the BBC transmitter and subsequent jamming on 5980 Kc.

Reports from listeners were requested and a special airmail souvenir verification sent to all who send the information to station OBX4Q, "Radio el Sol del Peru", Box 1711, Lima, Peru.

The other shortwave transmitter of "Radio el Sol" station OBX4C had been heard at fair strength on 15195 Kc from 9.00 am to 1 pm at which time the frequency is covered by Radio Australia on 15200 Kc. OBX4C is actually assigned 15180 Kc but is heard clear on the Radio Canada transmitter on 15190 Kc.

Programs are generally of Spanish dance relays with frequent commercial announcements, while news in Spanish is presented at 10.55 am. The station uses a novel and distinguished station break being a series of notes played on the Hammond organ, the station announces as OBX4X, OBX4Q and OBX4C, Radio el Sol del Peru, Lima.

BRITCOM RADIO-KURE

Interesting details on the British Commonwealth Radio at Kure, Japan, has been passed on to us by Sig. I. W. Lamont, serving with the Britcom Broadcasting Unit at Kure.

Established some 10 years ago the station was first known as WLKS and operated on the frequency of 6105 Kc, the same channel as used until recently. WLKS was key to a network of British stations which included one operated by the New Zealand Forces at Yamaguchi. The frequency of the broadcast band station has been recently changed to 1450 Kc from 1470 Kc. Power is 500 watts.

The short wave transmitter on 6090 Kc uses 100 watts. Crown Radio which operates in Korea, on 1290 Kc is also under the control of Britcom.

Britcom operates from 7.30 am-1.00 am and the frequency of 6090 Kc can be heard when interference from Peking on 6100 Kc and VL16, Sydney on 6090 Kc is not too severe. Broadcasts of news are relayed from London, Melbourne, Wellington and Montreal. The broadcasts for Canadian Forces are first broadcast toward Melbourne and it is then recorded and transmitted to Korea and Japan later by Radio Australia, this is caused by poor circuit conditions, between Montreal and Japan, ruling out direct transmission.

> Notes for next issue should be send to Arthur Cushen, 212 Earn St., Invercargill, NZ. All times are Australian Eastern Standard.

XEOI TESTS ON 6010Kc

RADIO MIL, XEOI at Mexico City has been testing on 6010 Kc to sign off at 6.05 pm. The identification announcement in Spanish "Radio Mil. estacion XEOI, transmitte en la frequencia de 6010 kilociclos, banda 49 metros, onda corta" was heard after each recording of Spanish music which made up the program. A request for reports and correspondence was also made by the station, and the addess was given to listeners as XEOI, Radio Mil, Ayuntamiento 101, Mexico 1. The slogan Radio Mil is the slogan mainly of the broadcast band transmitter XEOY on 1000 Kc this frequency being the basis of the slogan. Last winter we were able to verify XEOY after this station being a non verifier for several years, and from the requests for reports verification seems assured. XEOI normally signs off at 4.00 pm on 6010 Kc and should be received throughout the winter.

HONGKONG ON 3945KC

Radio Hongkong after operating for some 15 years on 9535 Kc. on station ZBW3 has been heard on 3945 kc. While tuning the 76 metre band one recent Saturday, we were surprised to hear a program of English dance recording on the frequency identification at 8.30 pm was given as "You are listening to radio Hongkong" and this was followed by a classical program, with BBC news at 9 pm. The station which is government operated has two networks, one Chinese and the other English carried on broadcast band. From the program presented we presume the station is an additional relay for the rebroadcasting of the English network. The address is Radio Hongkong, Box 2000, while the studio location is Electra House, 3 Connaught Rd., Hongkong.

FLASHES FROM EVERYWHERE

DYB4 is the call of the new Silliman University station located at Dumaguete City in the Philippines, and operating on 3275 Kc. Len Collett, Oamaru, NZ, who has sent this information, received the verification in the form of a card, letter and schedule. This 375 watt transmitter relays DYSR (840) and DYH4 (6055) 6.0 11.00 am and 6.00-11.00 pm. Signals are fair at 8 pm when a local language (Visayan) is heard during one of the normal religious broadcasts.

MADRID has begun operation with a new 100 Kw transmitter and has been widely reported from Europe and the area. The station announces the frequency as 7100 Kc but checking shows the frequency to be 7090 Kc. The schedule at the moment is very short the station only transmitting 6.00-7.10 am the first 40 minutes being in German and the balance in French. The transmissions are also carried on the normal 9365 kc frequency which now broadcasts the English program at 7.10 am.

HILVERSUM from the commencement of the new winter schedule has added several new frequencies, including 7260 9640 and 15405 Kc. The normal evening English service is reversed to the afternoon and is broadcast 12.30-1.10 pm on 9745, 9590, 6025, 5980.

FAR EAST NETWORK, Tokio are announcing the use of a new transmitter on 3800 Kc and this station appears to relay the FEN programs from 7.00-1.00 am. The possibility of receiving this station till near sign off is somewhat remote due to the use of this part of the 75 metre band by Australian and New Zealand amateur stations. Tokio is very strong on 11750 Kc and can be heard with news at 7.00 pm and the station signs off at 7.45 pm to re-open at 8.00 pm on 6160 Kc, both these frequencies with the same 10,000 watt transmitter.

SAIGON'S Radio France Asie broadcasting to New Zealand and Australia has ceased its scheduled first report by Ron McEwan, Melbourne, who gives the new schedule as 6.45-9.00 pm.

Broadcasts are still presented on 15 Kc and the popular Mailbag and Request program is still broadcast at 7.30 pm Fridays but during winter signals will be poorer. An approach by the station to the NZ Radio DX League with an offer of four special broadcasts a year and the success of this will depend on a new frequency in the 31 or 41 metre band in order to provide reliable winter reception.

BURMA and South Africa are to install high powered transmitters reports Radio Australia. The Rangoon transmitters consist of 4 RCA 50 Kw with special antenna array to give world wide coverage. The South African transmitters, 9 of 20 Kw power, will replace the existing 5 transmitters at Johannesburg and Capetown which give local coverage for the English, Afrikaans and Commercial services. Both these transmitting units are expected to commence operation next year.

VOA EMPLOYS 1000

Fourteen studios, and 1000 employees are housed in the new Voice of America headquarters at Washington DC, and located in the Health Education and Welfare Department building reports Broadcasting Telecasting. Some 38 languages are now broadcast, and the report that the staff are shot of 60 stenographers may account for the slow receipt of verifications.

The move of the Voice of America in November to Washington from New York was made at a cost of 2,600,000 dollars about £900,000.

THE HAM BANDS WITH BILL MOORE

The reflecting properties of the Ionosphere are affected by the number of sun-spots active. Amateurs are waiting for an increase in the number of sun-spots and anticipated improvement in DX working.

WS of the appearance of sizeable sun-spots in the new 11-year sunspot e provides some encouragement to DX fraternity and the next two years ld show considerable improvement he HF bands.

e last peak was in 1947 and it is gen-ly accepted that the sunspot minima in mid-1954. It should be remember-that the last cycle passed from a imum in 1944 to a maximum in 1947. this cycle follows a similar pattern bands should be wide open in 1956. 1946, when the HF bands were re-ied for use after the war, DX was e good, so next year may see a great ige.

hen the tremendous DX signals of 48 are remembered it is difficult to gine how the 14 Mc will sound with nany arrays beamed on each other. It ertain that some large holes will be ted in the receivers currently in use. eceiver selectivity will have to be im-ed if the weaker signals are to be ed. It is good news that new sunspots e appeared, with the possibility of e easier DX in the near future.

e proposed list of television frequen-published in some Australian radio nals, caused quite a stir in the VHF ernity. They had expected, according rumors circulating, that the 50 Mc d would be lost, but were not pre-d, however, to see section of their 148 Mc band listed for TV use.

At this stage, although no final announcement on the subject of frequencies has been made, the proposal has caused considerable concern.

It seems strange that in the US amateur bands at both 50 and 144 M/cs remain intact, despite the great number of television saions in service here, the area to cover is larger, with approximately 20 times the population.

Surely, if these frequencies were necessary for television coverage it would be in that country, not here in Australia. General VHF frequency usage in the US for commercial services must be many times in excess of similar use here.

Buffer bands of 2 Mc/s are also mentioned and transmitter power in these sections to be limited to 15 watts. This arrangement would account for the remaining two Mc/s of the 144-148 Mc band.

Even if some other frequencies are made available for amateurs in the VHF portion of the spectrum, the 50 and 144 Mc segments are international bands and much more valuable.

The final dictum on TV frequencies has not been made, but a grave injustice would be done to amateur radio in this country if these two bands were taken for other services.

It will be the duty of every amateur to strongly oppose any move along these lines through the WIA. The institute will need your support on this subject.

SUCCESSFUL FIELD DAY ON 144Mc

ER the Anzac Day week end the VHF section of the NSW Division arranged 44 Mc field day throughout Eastern tralia, similar in operation to their ng field day of 1954. Again the ob-was to relay from Sydney messages ther capital cities.

outes were arranged, both south and t in NSW to Victoria, it was hoped n there to Tasmania and South Aus-a and north to Queensland.

the net's 18 stations operated in the and 13 from home locations. Excel-contacts were made, in some cases ly reaching the 300-mile mark. Al-gh some of these distant contacts e made from elevated positions, many e over difficult terrain, with moun-s up to 4000ft intervening.

he only capital city reached on this sion was Melbourne. The message inated at 11.12 am and a reply was ived in Sydney at 1525 hrs.

he messages were originated by the ident of the NSW Division and ad-ssed to the presidents of the other es. They were routed on 144 Mc by ial station VK2WI.

me amateurs travelled over 300 es with portable equipment to cover tegic positions in the net relays. In field in the north of NSW were 2HO Mt. Ebor, near Armidale, VK2HE e Knob, near Taree, VK2ATO Barring-Tops, near Scone, in the west, VK2ANF Tomah, VK2ZAG Mt. Lambie, VK2LG Summit, VK2AZO Colo Heights, all the Blue Mountains, VK2AOA Mt orama, Bathurst, VK2JW Mt. Canoblas, nge, in the south, VK2AWZ Heath-, VK2AJZ The Gib, Mittagong, HL Mt. McAllister, Goulburn, VK2ZAA dall, Tumut.

Victoria VK3UI operated from Mt. key, near Seymour.

he message to Victoria was relayed via LG, 2ZAG, 2AOA, 2JW, 2WH, 2ZAA, O, 2RS, 3UI, 3WI. The reply was re-ed via 3UI, 2ZAA, 2JW, 2AJZ, 2WI. route north was via VK2ANF, 2AZO, , 2VU, 2ANU, 2ATO, 2HE, 2HO, out the coast to VK2AHH and also north VK2AQI Armidale, and finally to 2ATS Inverell. No further contact could be made toward Queensland and the message was returned by the same route.

Other stations operating portable included VK2DB, 2ZAR, 2AQC, while many stations operated from their home QTH.

The absence of VK3ATN from his home at Birchip over the weekend prevented any link through to VK5, although it is believed an alternate route is available.

Contacts over the 200-mile mark included those from VK2J to VK2HO/P, 268 miles, VK2ANF/P, to VK2HO/P, 252 miles, VK2WH to VK3UI/P, 320 miles.

Dozens of contacts were made in excess of 100 miles.

Adrian Rofe, VK2HE, journeyed north and was guided out to Blue Knob, out from Taree, by Bill Eagling, VK2AEY, and was to provide a valuable link in the northern net.

Journeying farther north from Sydney were Roy Hart, VK2HO, and Perc. Healy, VK2APQ, who settled 5250 feet up on Mt. Ebor, out from Armidale, and made excellent contacts to the coast and both north and south. They ran 20 watts to a three over three array.

A 60-watt transmitter was also available, but not used, as the smaller powered transmitter covered the distances required.

Perhaps the outstanding personal contribution to the success of the day was the journey of John Thornthwaite, VK2ATO, to Barrington Tops. From his guest house he climbed 4000 feet on foot, carrying all his radio equipment, bedding, &c. The 12-mile journey took eight hours on the trip up, the descent only four hours. Running only .2 of a watt to a four-element beam, he contacted VK2AJZ/P, at a distance of 180 miles.

Norm Skulander, VK2JW, on Mt. Canoblas, near Orange, was well equipped. He ran 75 watts input to 32 elements and was responsible for some excellent signals in Sydney at 140 miles.

The event was good practice for the Spring Field Day, to be held this year on the first weekend in October. Attempts will then be made to relay messages to all Eastern Australian States.

NEWS FROM U.S.A.

A FURTHER resolution is being introduced into Congress in the US to designate one week in June each year as National Amateur Radio Week. Last year a similar resolution died in committee.

In introducing the bill to the Senate, Senator Bush made the following address:—

"Mr. President, amateur radio operators in the United States have made invaluable contributions toward the advancement of radio.

In times of emergency, local and national, they have performed essential services to the public by providing a network of communications linking agencies dealing with disasters.

"The month of June was selected because during that month each year is held the American Radio Relay League's annual field day, in which more than 7000 amateurs throughout the country set up portable and emergency powered radio communications in remote areas.

"They man this gear in shifts for 24-hour periods. The purpose is to demonstrate the skill of volunteer amateur radiomen in providing emergency communication service in the event of disaster, military, civil or natural.

"The week of this event would be a most appropriate one for designation as National Amateur Radio Week."

The above remarks could be well applied to the work of Australian amateurs in emergency and in the field.

LICENCE INCREASE

The growth in the number of amateur radio licences in some 25 years in the US gives a clear idea of the manner in which the hobby can advance in a country where it is assisted by the authorities.

Approximately 1500 amateurs were licensed in 1920. In 1934 this figure had risen to 46,390. At the present time the estimate is 125,000, probably 80 pc of the world's amateur population.

The work of the Central Radio Propagation Laboratory, Cheyenne Mounts, Colorado, is described in a circular entitled "Cheyenne Mountains Tropospheric Experiments" and issued by the US National Bureau of Standards. At a cost of 40 cents it may be obtained from the Government Printing Office, Connecticut Av., and Van Ness St., North West, Washington, DC.

The circular is of great interest to the VHF gang and covers studies in tropospheric radio propagation in the VHF and UHF regions. Five transmitters are located between 92 and 1046 Mc/s, and four continuous recording field strength receiving stations are located at distances up to 226 miles from the transmitters.

Provisions are also made for recording at distances of 393 and 617 miles at various periods.

Accurate measurements of temperature, pressure and humidity are recorded electronically.

Refractive-index turbulence is also measured and all the theories of tropospheric propagation are being investigated.

CIVIL DEFENCE

THE final adoption of Civil Defence plans, as was implemented in NSW early in May, will allow amateur CD nets at present in operation to become part of a recognised organisation.

Previously, except in areas likely to be affected by flood or bushfire, it was difficult to hold the interest of amateurs in net operation. Some, however, have been always active since the inauguration of these nets.

f amateur radio networks are officially epted, as most certainly will be the e, they will be able in capital cities work with other authorities in supping supplementary communications. he WIA will undoubtedly offer the vices of their nets when the CD comnications organisation is set up.

hree civil defence zones are listed for W, at Sydney, Newcastle and Wollonng, under the control of the Director Civil Defence.

t is proposed that the whole of the erational organisation would be staffed volunteers. A period will elapse before n details are concrete and action can taken by the WIA along the lines anged Federally some years ago.

Queensland Convention

HE Downs Convention of the Queensland Division of the WIA was held at lm Beach, over the weekend, April 30th, y 1st, despite the flooding of areas in southern portion of this State.

Roads to Palm Beach were blocked by odwaters. It was not until the Sunday at amateurs could proceed, and finally attendance rose to 36 in the afternon session.

Visitors included six VK2's, 2YC, 2AOR, EU, 2UC, 2ATS, and 2VK.

Ramsay Bryce, VK4AB, and Noel Mar-, VK4PQ, were kept busy re-arranging program to suit the reduced sesns.

Divisional secretary Bill Young, VK4YA, th other councillors, was in attendance, d State president, VK2YC, Jim Corbin, presented the NSW Division.

The convention, it is anticipated, will the forerunner of many. It is only ped the elements will be kinder during ture events.

DX NOTES

The 21Mc band provided some interestg signals during April. Quite a numr of the old 10-metre gang have set-d there, undoubtedly just waiting for revival on 28Mc/s. South and Cenl American stations, including HC, HK, and KZ's, appeared in the mornings d plenty of contacts were made, dete the paralysing signals from ZL stans.

n the afternoons Africans peaked, ile signals from the Asians and Isds stations were audible all day.

14 Mc/s showed some improvement, , and around 2200 hrs to midnight od prefixes appeared, including OX and . Perhaps the sunspots are already ecting conditions.

Present-day DX operating techniques ve been receiving much adverse pubity in overseas amateur radio journals, d the actions of the many stations crially analysed, especially the crowding the rare DX stations' frequency.

n all fairness, it is pointed out that e solution is in the hands of the elue station by exercising his ability to minate a specified frequency that will be monitored for answers to his calls. By this means stations will be kept ay from his frequency and spread out some degree. The value of short calls d short QSO's is emphasised. Those stans in the hunt would be pleased if ur contact is limited to an exchange of ports and names. The fact that the stan being contacted is your best DX is t of great interest to anyone.

The habit of arranging for the DX stan to stand by for your friend is also iticised.

In the US skilled DX operators are deavoring to publicise these few carnal points in DX operating via the any radio clubs over there.

Self-discipline is the only hope to elimate the station piles and courtesy ll really pay in the long run. The DX ation will not then be driven or frightned off the band, as is often the case day.

VI PROBLEMS

The Press announcement made late in pril on the granting of television rences to two companies in both Sydney d Melbourne brings to mind the necesy of modifications to present transitters that will be required in and ound both cities.

Most transmitting equipment currently use does not lend itself to easy shielding and in many cases a complete rebuild will be required. It is generally reported that approximately eighteen months will elapse before TV services will be provided.

At least that time will be available for any changes. Fortunately, considerable research has been carried out on TVI and its prevention, and most of the answers will be available.

The NSW VHF section have already considered TVI and appointed a committee to investigate the problem. The members are as follows. Dr. Bob Black, VK2QZ; Max Sobels, VK2OT, Norm Beard, VK2ALJ, Bob Winch, VK2OA, Perc. Healy, VK2APQ, and John Miller, VK2ANF.

WIA NEWS

The new Federal president of the WIA is Major Bill Mitchell, VK3UM, who now fills the premier position in amateur affairs on the resignation of Bill Gronow, VK3WG.

Bill, VK3UM, was for a number of years Federal secretary of the institute, prior to his departure to attend a staff college in England. He is well versed in the Federal WIA sphere and amateurs in Australia wish him success in his new position.

A committee has been appointed by the NSW Division of the WIA to organise lectures for the monthly meetings. Members include Angus Robertson, VK2IQ, Dud Millen, VK2LQ, Harry Chinner, VK2CG, and late UHF section secretary Cess Cronin.

The members cover a wide and varied field in the commercial radio sphere and should be able to supply valuable lectures for future meetings.

Terry Tatham, aged 16, is a patient at "Cherrywood," the hospital of the Polio Society in Pacific Highway, Turramurra. A victim of polio, he has to spend most of his time in an iron lung. Terry would like to take up amateur radio as a hobby, and any amateur who lives nearby could be of great assistance in putting the lad on the right lines in the early stages. He can be contacted through the matron at the above hospital.

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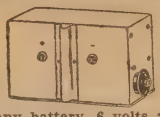

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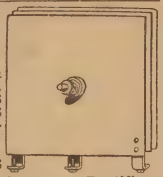

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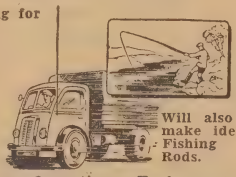

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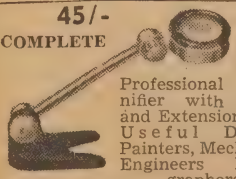

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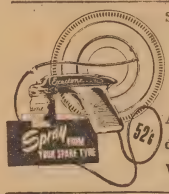

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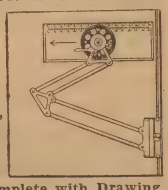

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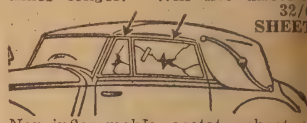

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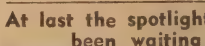

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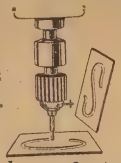

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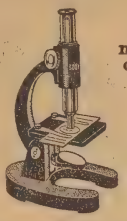

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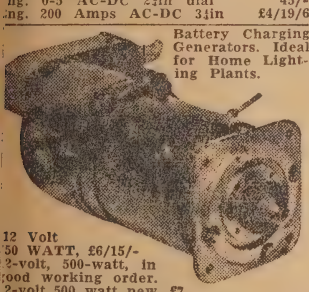

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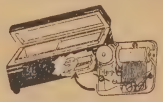

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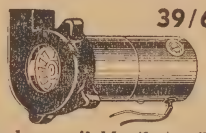

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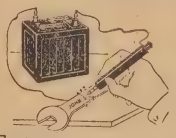

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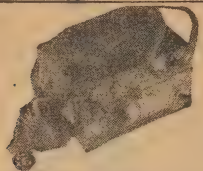
Extra strong double lens Eyeglasses 15/-

Screwdrivers, set of five 13/9

SPECIAL OFFERS FROM OUR NEW MOTOR ACCESSORY DEPARTMENT

American Schrader tyre pumps, work from your spark plugs, 39/6. Car type fire extinguisher. Every car should carry one. Cost £7/10/-. £4/10/-. Steel mechanic's tool boxes, 19/6. Brand new 7/8in spark plugs, suit most old type cars, 2/6, or ideal for tractors S.A.E. or Whit. Spanner Sets, open one end, ring the other. 6 spanners to set, 23/6. Army steel tow ropes, looped ends, 17/6. S.A.E. open end spanners, 6 to set, 24/6. Whitworth, 4 to set, 18/6. Whit socket sets, 13/6 set. Mudguard type rear view mirrors, 16/6. Inside car rear view mirrors, 4/11. S.A.E. socket sets, 15/-. Stick on type ash trays, 4/-. Engineer's pliers, 4/6. Car jacks, 37/6. Tyre levers, 3/10 each. Hydraulic 2-ton jacks, £4/15/-. 6 volt windscreen wipers, £4/12/6. 12 volt £4/19/6. Car pumps, 14/-. Shifting Spanners 4in, 6/9; 6in 8/-; 8in 10/-; 10in, 11/-; 12in, 18/6. Metric Socket Set, complete with bar, 59/6. Feeler Gauges, 4/6. Tail Lights, 5/9. 12in Steel Rulers, 3/6. 6in, 2/6. Set of 3 Screwdrivers, 2/6. Hydrometers, 11/6. Piston Ring Compressors, 15/-. Pressure Oil Cans, 59/6. Combination Pliers 5/6. Multi Grips, 10/6. Car Amp Meters, 15/6. 4½in saw blades complete with arbor, ideal for making saw bench with electric drill, 25/-. Bell-ringing generators, ideal for telephones, 25/-. German Army marching compasses, work similar to prismatic, 29/6. 110 volt 1000 watt projector globes, 32/6. ¼in Black and Decker 230 volt electric drills, £11/15/-. ½in, £24/8/3. Magnifying Glasses, 8 mags., 8/6. 10 magnifications, 12/6. 24 volt motor and hydraulic pump, capacity 3½-gals. per minute, £3/15/-. New headphones suitable for crystal sets, 17/6 pair. New Army Mosquito nets, ideal camping, 27/6. Genuine RAAF Berets, 10/6. Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, 39/6. 230 volts input. Brand new American Cutting and Welding Torches £4/4/-. complete. Army Slouch Hats in good order, 15/-. Generator Test Meters, 35-0-35 amp meters, 4½in dial, 45/-. 0-10 volt meters, 4½in dial, 45/-. Loading Reristors can be supplied to make meter read 10.20 at 12/6. Medical Scalpels, many uses, photographers, etc., 6/6.

MOTOR SPARES LTD



2-VALVE AMPLIFIER

Type A1134, less valves.
Components in each amplifier—
1—8 pole PMG type switch, 3 position, toggle.
1—2 way toggle switch.
4—Transformers Audio input and output.
A number of resistors and condensers all in metal box. 6¾in x 4¾in x 4¼in. **Price only 15/-**

BLOWER MOTORS

26 volts D.C. Input. Fan and Housing of same can be removed and pulley fitted if required. Will operate off 32-volt light plant. In excellent condition. **Price 29/6**

Chieftain Multimeter

New model using 100 ohms internal resistance meter, sensitivity 1000 ohms per volt. Voltage readings 0-15, 0-150, 0-300, 0-600. Ohms 0-100,000. This is pocket size meter, ideal for the electrician, serviceman, amateur, motor mechanic and handyman. **Price only £4/12/6**

CATHODE RAY TUBES

New and boxed at reduced prices.
5BPI 5in 39/6
VCR97 6in 39/6

IFF SETS TYPE R3121

in new condition with 13 valves, 18 volt to 450 volt at 50 ma genemotor and blower, carbon pile regulator, 3 multi-contact relays and dozens of resistors and condensors of all types.
Price only £4/10/-

PE94A GENEMOTORS

as used for SCR 522 transceiver Input volts 28 DC.
Output volts 300 DC at 250 ma
150 DC at 10 ma
16 DC at 5 amps
These are enclosed in metal box with voltage regulator, cooling fan and filter circuit. **Price only 25/- ea.**

RESISTORS

All brand new and in good cond.
Carbon 1 Watt listed in ohms. 250, 300, 350, 400, 450, 500, 600, 650, 800, 850, 1000, 1500, 2000, 3000, 4000, 4700, 5000, 6000, 10,000, 12,000, 15,000, 25,000, 40,000, 60,000, 70,000, 75,000. .1 meg, .15 meg, .2 meg, .25 meg, .3 meg, .35 meg, .5 meg, 1.5 meg, 1.75 meg, 2 meg., 2.3 meg, 3 meg, 5 meg.
Price only 4d each, 3/- doz, £1 per 100.

Carbon ½ watt listed in ohms. 50, 300, 500, 600, 2000, 5000, 10,000, 20,000, 25,000, 40,000, 50,000, 60,000, 100,000. .25 meg, .3 meg, .5 meg.
Price only 3d. each, 2/6 doz 16/8 per 100

Carbon ½ Watt listed in ohms. 250, 300, 320, 350, 450, 600, 750, 800, 880, 900, 1000, 1200, 1300, 1700, 1800, 1900, 2200, 2400, 2600, 2700, 3000, 3200, 5500, 4300, 6500, 7500, 7900, 8000, 10,000, 13,000, 15,000, 25,000, 37,000, 50,000, 90,000, 150,000 160,000, 250,000, 350,000, 400,000.
Price only 3d each, 2/3 doz. 15/- per 100

Carbon 2 Watt listed in ohms
10,000, 80,000, **Price 9d each.**
Wire Wound 3 Watt. 7, 12, 21 ohms **Price only 8d each.**
Wire Wound 5 Watt. 9, 1250, 1500 ohms. **Price only 9d each.**
Wire Wound 8 Watt. 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750 ohms. **Price only 1/- each.**
Wire Wound 10 Watt. 100, 150, 300, 500, 1250, 1500, 1750, 2500 ohms. **Price 1/- each.**
Wire Wound 12 Watt. 800, 4500, 14,200 ohms. **Price only 1/3 each.**
Wire Wound 20 Watt. 50, 75, 125, 150, 175, 200, 250, 300, 400, 500, 750, 1250, 1750, 4000 ohms. **Price only 2/- each.**
Wire Wound 25 Watt 50, 75, 100, 125, 175, 200, 250, 300, 400, 750, 1250, 1500, 1750, 3000, 4000, 7500 ohms. **Price only 2/6 each.**
Wire Wound 40 Watt 1 pc Resistors, few only, 2000, 4000 ohms.
Price only 4/6 each.

British Navy Heavy Duty Resistors.

50 ohm 10 Watt	**2/- ea.**
100 ohm 40 Watt	**4/- ea.**
250 ohm 20 Watt	**2/6 ea.**
300 ohm 85 Watt	**5/- ea.**
350 ohm 25 Watt with variable tap	**2/6 ea.**
700 ohm 20 Watt	**2/6 ea.**
850 ohm 20 Watt	**2/6 ea.**
2500 ohm 10 Watt	**2/- ea.**
4000 ohm 20 Watt	**2/6 ea.**
5000 ohm 20 Watt	**2/6 ea.**
5000 ohm 27 Watt	**2/6 ea.**
10,000 ohm 40 Watt tapped at 3000 ohms	**4/- ea.**

SPECIAL NOTICE

All parcels sent Registered Post unless otherwise stated. Postage or Freight must be included with order.

SPECIALS

1. Record Changers. Reconditioned Single Speed, Record Changers, guaranteed in working order. Well known makes: Garrard, Collaro, H.M.V.. Stromberg Carlson, Plessey. **Price only £5 each.**
2. Single Speed Motors with pick-up and automatic stop. Reconditioning guaranteed in working. order. **Price only £2/17/6 each.**
3. Germanium Diodes. Ideal for Crystal sets, also for rectifiers in meters and radio set detectors. **Price only 4/11 each.**
4. 6½in Speakers, Brand new and Boxed with 5000 or 10,000 ohm, transformer. Well known brand Worth 55/-. **Our price 35/-.**
5. .001 Mica Condensers 10,000 volts peak. **Only 5/- each.**
6. .01-10,000 volts wkg condensers in perfect condition, only **4/6 ea.**
7. .02—10,000 volts wkg condensers, only **7/6 each.**
9. Magnetic keys. As used by British Navy. High resistance coil and 2 heavy 2 way contacts. **Price only 3/6,** weight 5¼lb packed.
10. 6 volt vibrator transformers suitable for Car Radio. Worth 45/-. **Our price 19/6.**
11. Undercar Aerials complete with shielded lead in and plug suit Astor and Airchief car radios Worth £4/10/-. **Our price £2/5/-.**
12. Throat Microphones in new condition. **3/6 each.**
13. Microphone Adaptors, designed to adapt the throat mike to the amplifier input, new condition, **5/- each.**
14. Cord assembly to adapt throat mike to adaptor has the necessary plugs etc. **2/6 each.**
15. CD508A Cord assembly with phone plug, 2 pin socket and press to talk switch. **Price 2/6 ea.**
16. Phone Jacks closed circuit type, brand new and perfect. **Only 2/6 each.**
17. Morse Code Sets, each unit built on baseboard and has key, buzzer, battery and connections for headphones and line. Ideal to learn the morse code. Brand new, made in England. **Only 18/6 each.**
18. Power Control Boxes. BC958A and BC965A selector control boxes combined. Size overall 6 x 6 x 2. Each pair of units has the following parts:— 2 Culter Hammer N.P. Toggle switches, 1-5 pin heavy duty plug and socket, 1-7 pin heavy duty and socket 1-6 position wafer switch with pointer knob. **Price 6/6.**
19. Micro Switches multi contact type suitable for all voltages up to 240. Worth 17/6. **Only 3/9 ea.**
20. Resistor Banks Consisting of 36-½ meg, 1 watt I.R.C. resistors mounted on 2 polystyrene strips **Only 7/6 each.**

547 ELIZABETH ST., MELBOURNE ALSO AT — ALBURY ARARAT BAIRNSDALE BALLARAT BENALLA BENDIGO BROKEN HILL COLAC DANDENONG ECHUCA SALE FRANKSTON GEELONG MILDURA SHEPPARTON ST. ARNAUD WAGGA WANGARATTA WARRAGUL

GETTING YOUR AMATEUR LICENCE

(Continued from Page 73)

quencies and avoid having too nch at the higher frequencies.

Most FM transmitters are de- ned for single band operation in uch the degree of frequency mul- lication can be determined to suit nt only the best practicable illator frequency but also the ber of multiplication required to ve the desired maximum devia- n.

One other point should be men- ned before leaving the element- y discussion of FM, and PM, and is relates to the matter of side- nds.

In an AM transmitter, the side- nds occur on each side of the car- r, and their limit is set by the ghest modulating frequency.

If this is 5 Kc, and we will assume single tone at this frequency for nplicity, then there will be a side- nd on each side of the carrier aced 5 Kc from the centre fre- ency.

DEBANDS

In the case of FM and PM, how- er, there will be a whole series sidebands, each displaced from e carrier centre by an amount ual to the modulating frequency. Assuming again a 5 Kc modulating ne, the first sidebands will occur Kc on each side of the carrier, d every 5 Kc thereafter in minishing amplitudes.

The strength of these sidebands rather a complicated matter to alyse, but the important thing to member is that the power in the rrier is distributed among them a ratio determined by the modula- on index, which is the carrier frequency divided by the highest modulating frequency.

It is obvious therefore that in a communication system, where the total bandwidth to be used must of necessity be kept within limits, the modulation index must not be high.

There is a contrast here with AM in which the carrier power is supplied by the modulator, and has no relationship to frequency. At peaks of modulation there is actually four times the normal carrier power available when it is modulated 100 pc.

CARRIER POWER

But with FM and PM the total carrier power can never be more or less than its nominal figure under any circumstances of modulation. It it quite possible, and actually happens with a modulation index of 2.4, that the radiated power is all contained in the sidebands, with no radiation at all at the centre frequency.

This simply means that the frequency displacement is enough to move the time phase so much that at the centre frequency it falls to zero. With high degrees of modulation index the phase at the centre will actually go beyond zero, and begin to swing in the opposite direction.

A complete understanding of this point lays emphasis on one's ability to think of the carrier in terms of phase-time displacement as well as in terms of frequency shift, and to analyse it further would be merely to quote passages from textbooks which are available when you wish to expand your initial ideas of the subject.

CHEAP PORTABLE X-RAY UNIT

THE need for a truly portable x-ray machine has always been major requirement of medicine nd industry, but, so far, most at- mpts to reduce the size of con- entional equipment has only been hieved at the expense of perform- nce.

A completely new approach to the roblem is a very small x-ray unit eveloped at the Argonne National aboratory of the Atomic Energy ommission in the USA.

The unit does not employ the onventional x-ray tube with its as- ociated high voltage power supply. nstead, the active component of the nstrument is a tiny particle of hulium, made radio-active in the eavy water nuclear reactor. Thu- um is an extremely rare material hat heretofore has found little prac- cal application.

MOUNTING

The thulium is mounted in a holder nd shield equipped with a shutter echanism, which is operated by a tandard photographic cable release. he container, which virtually com- rises the entire x-ray plant, is in the form of a cylindrical canister which weighs only 10 pounds and can be held in one hand.

The unit is expected to meet the long-time need for simple, cheap, and portable equipment for making x-ray photographs. In spite of its small size the radio-active thulium provide rays that are comparable in energy to a 100,000 volt x-ray machine. In addition, it does not require an electric power supply as does conventional x-ray equipment.

BRITISH IDEA

The use of thulium as an x-ray source was first suggested by British scientists, who have developed a similar but less powerful instrument. For medical purposes equipment of this kind will be of greatest value in isolated locations such as army field hospitals, naval vessels, and isolated construction projects.

Industrially, it should also prove extremely valuable, one potential use being to determine the height and densities of liquids in closed systems.

A 2-STAGE TRANSISTOR RECEIVER

(Continued from Page 39)

month, production type transistors have yet to reach the stage where one can arrange smooth regenerative circuits around them, which will allow them to match the performance of a regenerative valve detector.

But, in the meantime, you're going to have a lot of fun with this present little set, learning about transistors and how they amplify. You're going to be one step nearer the day when you'll put away the "breadboard" and build yourself a really hot little transistor set for use inside the house and out.

Finally, just for the record, and in case you haven't the last issue on hand, we repeat the coil specifications:

The coil is wound on a 3in length of 2in diameter former with 22 B & S enamel wire. It comprises 80 turns in all, and has every fifth turn up to 50 lifted over a wooden match so that it is accessible for tapping purposes.

CONDENSER CONNECTIONS

The .0004 mfd. (approx.) tuning capacitor is connected right across the coil, but the detector and aerial are usually tapped quite close to the earthy end. The closer they are tapped to earth, the better will be the selectivity—but the volume will also be reduced.

In the average suburban location and with an outdoor aerial, the original set worked quite well with the detector and aerial tapped, either separately or together, 5 or 10 turns from the earthed end.

Here's Your Answer Tom

(Continued from Page 45)

the idea, Tom, that light is the only kind of electro-magnetic radiation. Far from it. But most people are familiar with the behavior of light, and reference to it makes for easier understanding.

For instance, radio waves are just as subject to reflection as are light or any other waves (permanent waves being probably the only exception).

The only difference is, that they have considerably longer wavelengths than light waves. Even what are referred to as very short waves, are still measured in centimetres, not in fractions of microns. (1 micron: .001 mm.)

Even though the reflecting surface must be bigger than the wavelength, wire meshing, or just a grid of metal bars, is sufficient to reflect such waves. Television and radio telephones, using the VHF radio bands, are often troubled by reflections from walls or rocks. These reflections are known in TV parlance as "ghosts".

On the other hand, it would take quite a substantial mountain side to reflect radio waves in the broadcast band, which have wavelengths up to 600 metres.

To round off:

Radio waves, heat waves, light, ultra-violet radiation, x-rays, gamma rays, cosmic rays, &c., belong to the family of electromagnetic radiation. They have a definite frequency, and consequently a definite wavelength.

All of them obey certain basic laws. However they react differently to obstacles placed in their way. This is due also to a basic law, which determines their behavior, taking into account the size and nature of the obstacle, in relation to the wavelength of the radiation concerned.

AERIALS FOR TV

(Continued from Page 41)

involved in providing reception in large apartment buildings. The gain of the receiving antenna must be sufficient to offset the losses of the feed line, and provisions must be made to isolate the various receivers to prevent interaction between them.

Cathode-folower isolation stages or resistive isolation pads are usually employed for the latter purpose. Special attention must also be given to lightning protection in such installations, since an antenna on a high place is especially prone to such phenomena.

Low losses, consistent with economy, is the main factor to be considered in the choice of the transmission line between the hill-top antenna and the receiver distribution point. Special consideration should be given to the high impedance, open wire line and the surface wave transmission line. The cost of installation of the latter decreases with frequency, making it attractive for UHF use. (From Aerovox Research Worker.)

RAYS THAT KILL OR CURE

(Continued from Page 19)

forms over the surface of the material slowing down the evaporation with a rise in working temperature.

With radiant infra-red heating a draft of air playing over the surface of the wet material further aids fast drying.

Philips Electrical Industries have carried out considerable research with infra-red and have developed very efficient lamps to be used for purposes, in addition to those mentioned, of mass heating, softening plastic materials, hardening thermo-setting glues, pre-heating machine parts, drying electrical equipment, assisting seed germination, pre-heating metal for soldering, biscuit making, bodily warmth, treatment of rheumatism and so on.

Infra-red rays are truly most versatile and their application is one of the great triumphs of science for the benefit of all.

LIGHT AMPLIFIER

(Continued from Page 21)

phosphor screen to give off light. Ultraviolet energy falling on the screen causes a faint glow, but there is no amplification. Amplification occurs only with voltage and the ultraviolet.

Proof of true amplification is obtained by measuring the number of photons of light striking the screen and comparing this with the number given off. Increases of at least 10 times have been measured and the company believes much higher ratios are possible.

Because the amount of light produced is proportional to that striking the surface, it is possible to brighten intermediate shades of the picture being projected, making a brighter picture without "washing out" contrast.

The new light-amplifying phosphor, the basis of the light amplifier, was a development of D. A. Cusano, a young General Electric scientist who conducted the demonstration.

FROM THE SERVICEMAN WHO TELLS

(Continued from page 59)

tor had stuck and been subntly freed by the rather conble handling of the amplifier was loaded in and out of cars enerally shaken about, or (2) someone had connected the on to the battery the wrong around.

s could cause a heavy current w in the filter electrolytics might be sufficient to blow use. In support of this was act that the fuse appeared to ther on the light side.

yway, whatever the cause I unable to reproduce it and I only hope that it was not hing which would occur again few hours. With this thought nd I screwed the back on the and gave the thing one last before passing it over to its lian—whereupon the vibrator d once again!

OT TIP

cok the back off the case and d the vibrator very lightly. t: it started immediately. I ed to take the chassis right of the case where I could get better and reached down to nnect the battery leads. The moment I withdrew my hand tly, for the battery clip was hot gh to burn—or to make me it could!

is new clue provided a very al reason why the vibrator had ed to start. The heat could be due to a high-resistance joint, ing considerable voltage drop his point, which is as good a n as any for a vibrator not ng.

re careful examination of the showed two main reasons for osses. One was hidden inside able insulation, where all but or four strands were broken e point where it was clamped e clip. The other was simply een the clip and the wire, the ping screw not being properly ened.

ter I had repaired these two s I felt that there was every ce that the unit would work factorily for a few hours at possibly much longer. This confirmed by repeated starting which were entirely satisfac-

ile making these tests I forted a theory as to why the tor had failed on the two pre- occasions, yet had started posi- at all other times when I was g it.

On both the occasions that it had failed the unit had been turned off for some time and the heaters would be quite cold. Now a cold heater has a very much lower resistance than a hot one (I believe I have seen a ratio of seven to one quoted for some types), so that the losses across the high resistance joint would be quite high in these circumstances.

On the other hand, my continual starting and stopping tests would have allowed the heaters to remain near normal operating temperature, since the power was off for only a few seconds at a time to allow the reed to come to rest. The difference in loss across the joint could have been sufficient to effect the starting of the vibrator.

Of course, all that is just a theory, since I had neither the time nor the facilities to check. Nevertheless, it might be worth keeping in mind.

Of more immediate interest was the fact that the set appeared to be performing reliably and I handed it over with the hope that it would stay that way.

But, alas for all my hopes. I met the chap concerned later in the evening and asked him how it behaved.

"No good," he replied.

"Why, what happened?" I asked.

"Well, we took it back to the hall, left it there while we had lunch, then came back later to pick it up for the other meeting. In view of all the trouble we had had we decided to test it on the spot before we took it out. All we could get out of it were some funny noises."

"What kind of funny noises?" I asked, feeling somewhat disappointed and frustrated over the whole business.

"Oh, you know, funny whistles and squeals. Hard to describe. But I'm sure it would have been quite useless."

He went on to say that he would bring the set over to the shop as soon as he had a spare moment, and have me give it a thorough overhaul, adding that he would like a new vibrator fitted, regardless of whether it could be proved faulty or not.

While I agreed that this was a good idea, I was not completely satisfied that the system had really failed.

I had—and still have—more than a sneaking suspicion that the "funny whistles and squeals" were nothing more than the old enemy, acoustic feedback, which could be quite violent if the control happened to be left flat out and the thing turned on in an empty hall. Considering that the users have absolutely no technical knowledge of any kind, it would be quite possible that they could fall into this trap.

And there, for the moment, the matter stands, because I am still waiting for the set to be delivered. When it does I shall be most anxious to find out just what is wrong with it—if anything.

NEW AMERICAN INDICATOR-UNIT

These indicator units contain the following valves:-

Six 6SN7GT, one 6G6, one 6H6, one 6X5GT, one 2X2 and 3BP1 C.R.O tube which is fitted in a separate shield on a 4ft shielded lead and supplied with control box and plug; case and shield are finished in black brocade. In original cartons.

£8/15/- F.O.R.

TRANSFORMER TO CONVERT THIS UNIT FOR 240 VOLT OPERATION AVAILABLE AT £3/15/- EXTRA plus postage.

NEW 5 VALVE D.W. BATTERY CHASSIS

This D.W. battery mantel chassis which is made by leading manufacturer is fitted with heavy duty Rola 6in speaker, tone control, etc and gives excellent reception on local, interstate and overseas stations. Ideal for building into existing furniture, boats, caravans etc. Valves used — two 1T4, one 1R5, one 1S5, one 3V4.

£5/17/-

NEW VALVES CAN BE SUPPLIED AT £3/10/- EXTRA

Postage and packing on chassis extra NSW 17/6, interstate 25/-

MIDGET GENEMOTOR

Input 28 to 32 volt at 1.1 amp output. 250v. New in carton at 60MA

£2/5/-

Used but in good order

£1/10/-

Postage extra.

Input filter supplied with genemotors

28 VOLT GENEMOTOR

Input 28 to 32 volt. Output 250v at 65mA. Used but AS NEW

£1/5/-

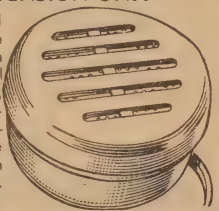
POSTAGE EXTRA

NSW 5/-, Interstate 11/-

—WANTED—

TEST EQUIPMENT, COMMUNICATIONS RECEIVERS, SURPLUS STOCK, ETC. HIGHEST PRICES GIVEN.

PILLO-FONE EXTENSION-UNIT



It's a real miniature with Rola unit. Install it anywhere in the sick-room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3¼in Diameter by 1¾in deep.

NOW 17/6

PLUS POST

GIBSON-GIRL TRANSMITTERS

Containing hand generator giving 12V low tension and high tension. 12SC7 and 12A6 valve, condensers, relays., etc.

NOW £2/10/- F.O.R.

CONDENSER SPECIAL

American Dubilier oil filled paper condensers. 15 M.F.D.—600 Volt

NOW 10/-

PLUS POSTAGE

NEW H.F. TRANSCEIVERS

RT 34-APS 13 (Tail-end-Charlie) Freq. 420 mcs. contain 16 valves 9-6AG5, 5-6J6, VR150 and 2.2D2. Also midget 24v Genemotor.

£10

Less valves—£5/-/-

FOR CONSISTENT LOW PRICES ON ALL DISPOSAL AND SURPLUS EQUIPMENT

METROPOLITAN RADIO SUPPLIES

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SPECIAL PURCHASE OF CHANGERS & SPEAKERS

NEW 5in AND 6in PERMAG SPEAKERS BY LEADING MANUFACTURER

(E) 5in STANDARD 24/6
(F) 5in HEAVY-DUTY 26/6
(H) 6in HEAVY-DUTY 29/6

Available with 10T or 7T Transformer.

POSTAGE & PACKING EXTRA
N.S.W. 4/6—INTERSTATE 5/6

NEW "VELVET-ACTION" RECORD CHANGERS BY STROMBERG CARLSON

Model 104—Three speed automatic plays all microgroove and standard records—in original cartons, £16/17/6, F.O.R.

ALL GOODS ADVERTISED ON THIS PAGE ARE NEW

VALVE SOCKETS

Teletron Standard Octal Sockets (moulded bakelite) **3/6 doz**

Eight pin loctal sockets moulded **3/6 doz**

Six pin wafer sockets, 2/6 doz
(All plus postage.)

ELECTROLYTIC CONDENSERS

2mfd 525 V ... 3/9
20mfd 12 V ... 2/-
4mfd 600 V ... 1/9
4mfd 350 V ... 2/-
20mfd 40 V ... 1/6
(Plus Postage)

12 inch P.M. SPEAKERS

Heavy duty 12in per-mag speaker by well-known manufacturer. 10T. C.T. or 5,000 transformer. **NOW 47/6**
POSTAGE NSW 5/6, Interstate 7/6.

ACOS CRYSTAL PICK-UPS

English Acos pick-up with bakelite arm and high fidelity crystal cartridge. Supplied with two sapphire needles **22/6**
(Plus Postage)

POWER TRANSFORMERS

Ferguson-midget Power-trans. 240v ppi. 265 x 265 at 50MA and 6.3v secondaries ... **22/6**
Post.—N.S.W. 3/6—Interstate 4/-.

RECEIVING VALVES

IT4	11/6	VR105	15/0
1S5	15/0	VR150	15/0
3V4	15/0	2050	15/0
1R5	15/0	955	7/6
6SA7	10/6	957	7/6
6SQ7	10/6	9001	7/6
6SN7	10/6	9004	7/6
6AG7	10/6	717A	7/6
6SL7	10/6	7C5	7/6
6AC7	10/6	EF50	10/6
6AG5	12/6	VR65A	2/6
6J6	15/0	1K5	2/6
6J7G	10/6	12SR7	2/6
EL33	12/6	12SQ7	2/6
EBF35	12/6	6SH7	7/6

ALL PLUS POSTAGE

NEW 12v VIBRATOR KITS

These new vibrator kits contain standard A.W.A. six pin synchronous vibrator, upright mounting potted vibrator transformers, two 8MFD electrolytic condensers, H.T. and L.T. chokes and vibrator socket. Output 200v at 50ma.

45/-
(Plus postage)
Ideal for car sets, small amplifiers etc.

ACOS CRYSTAL PICK-UP CARTRIDGES

These Acos units are suitable for replacement on most 78 pickups. Supplied with set screw.

NOW 10/-

TRANSMITTING VALVES

813	£2/0/0	803	£2/0/0
866	15/0	837	£1/10/0
100TH	£2/0/0	1616	£1/10/0
832	£2/0/0		

I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 & 2 watt, in values 50 ohm to 5 meg. including many popular sizes, 3T, 15T, 20T, 25T, 50T, 100T, 250T, 500T, etc.
(Standard resistor color code supplied).
20/-.
(Plus 1/6 postage.)

VIBRATORS

6 volt A.W.A. gas-filled vibrators. Heavy duty synchronous
NOW 7/6 or 70/- per doz

NEW IT4 BATTERY VALVE
11/6 ea.

PICK-UP CARTRIDGES

Rothermel high fidelity pick-up cartridge. Replacement for most pick-ups. **7/6 ea.**

SAPPHIRE NEEDLES

Rothermel sapphire needles play 2,000 recordings. Made in England. **3/9 or 30/- doz.**

DYNAMIC SPEAKERS

7in Dynamic speakers by leading manufacturer,
1,500 ohm Field coil,
7,000 ohm Transformer
or
Ovaltone Dynamic Speaker
9in x 6in. 1,000 ohm Field, 5,000 or 7,000 ohm Transformer
NOW 20/- EACH
(POSTAGE—NSW 3/9, Interstate 5/9.)

Please address all correspondence to 479 Parramatta Rd., Leichhardt, N.S.W.

METROPOLITAN RADIO SUPPLIES

479 PARRAMATTA ROAD, LEICHHARDT
N.S.W. PHONE LM3610

640 KING STREET, ST. PETERS,
N.S.W. PHONE LA6087

A.T.5 TRANSMITTER

A.T.5. Transmitter covering 140 K.C. to 20 M.C. in two separate tuned circuits. Provision for crystals. Complete with valves. Three 807 and two 6V6.

£4/17/6 F.O.R.

A.T.5 POWER SUPPLY

24 volt genemotor supply containing two genemotors, one giving 550 volts at 350 mills and the other 250 volts at 100 mills. Also contains filter condensers, relays, fuse holders, etc. **£2/10/-** F.O.R.

OIL FILLED CONDENSERS

(Working voltages stated)

20mfd. tapped	600v	17/6
2mfd.	1,750v.	12/6
3mfd.	2,000v.	17/6
4mfd.	500v.	6/6
4mfd.	200v.	4/6
8mfd	400v.	8/6
.5mfd.	200v.	2/9
.25mfd.	750v.	2/9
.01mfd.	3,000v.	5/-

all above plus postage

12ft TANK AERIALS

These are suitable for car or truck aerials or make ideal fishing rods. Contains three 4ft sections of tapered spring steel. (Cannot be sent per. post.)

17/6 F.O.R.

SHOCK MOUNTS. NEW

Protect your equipment with these mounts. Set of 4 mounts and rack. 11in. by 8in.

WERE 5/6 NOW 3/6

PLUS POSTAGE

AIRCRAFT BOMB SIGHTS

These sights contain 4in spirit filled compass with corrector. two spirit levels, rack and pinion and many useful gears. The unit is mounted in wooden case with locks and handle.

£1/17/6 F.O.R.

FULLAPHONES

Containing pair headphones, morse-key buzzer, key switches, etc., in case. **20/-**

Post—N.S.W. 7/- — Interstate 11/-

HIGH RESISTANCE HEADPHONES

3,000 ohm. Headphones made by S.T.C used but in good order. **20/-** Plus postage

HEADPHONE TRANSFORMER

Low to high impedance headphone transformers with plug and jack.

3/6 Plus postage

NEW RELAY-TYPE COUNTERS

These Electronic Counters counting from 0 to 9.999 have a 250 ohm coil

Supplied in brocaded finished box complete with rectifier and transformer for 240v AC operation. **£2/5/-**

Plus Post

PLUGS AND SOCKETS

New 26-pin shielded plugs and sockets with silver-plated contacts.

5/- pair, plus postage

5-pin shielded plugs and sockets **2/9**

DISPOSAL VALVES TESTED

807	10/-
6SH7	2/9
866	10/-
6SA7	7/6
12SR7	2/6
12SQ7	2/6

Plus postage.

A.M.R. 300
COMMUNITAIN-RECEIVER

This first class 10 valve receiver made by S.T.C. has a band spread coverage of 1.5 to 24 mcs in switched bands—240 volts AC operation — supplied complete with valves, crystal, S meter and speaker, air tested. **£47/10/**

F.O.R.

New 12 volt vibrator supply for above complete with leads, spare valve and vibrator 3-6 x 5 and 2 vibrators. **£5/15/-**

F.O.R.

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METROPOLITAN RADIO SUPPLIES

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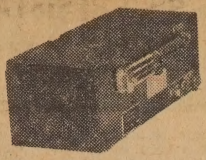
LEICHHARDT, N.S.W.
PHONE LM3610

640 KING STREET, ST. PETERS,
N.S.W.
PHONE LA6087

AMERICAN RADAR TRANSMITTER TYPE ASB



ontains

wo U.H.F. Triodes Type 15 E.
our Sets of Lecher Bars.
ransformers, ceramic mountings, Motor Blower, etc. Also
igh Voltage Vacuum Change Over Relay. Nominal frequency
15 m/cs. Ideal for conversion to U.H.F. Channels Variable
oaxial Cable and Link Matching Lines. Contained in Alumin-
m Case.

£2/10/-

Freight extra.

NEW H.F. RECEIVER — R3118

(RESPONSE UNIT)

he ideal receiver for the 144 Mc band with 2 RF
tages uses 13 6.3v. Valves complete with 240v AC power supply.

£10/-/-

NGLISH I.F.F. MOTOR

glish I.F.F. motor complete with
rbox. 18v D.C. operation but suit-
e for conversion to AC.

ere £2/10/-, Now 37/6

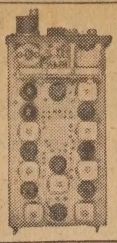
tage extra — N.S.W. 5/- Inter., 8/6

SCR522 GENEMOTORS

28 volt input regulated and filtered; output filtered 300 volts at .26 amps; 150 volts at .01 amp; 14.5 volts at 5.0 amps.
Completely shielded in metal case, 12 x 8 x 5 inches. Price, F.O.R. Each

F.O.R. 20/-

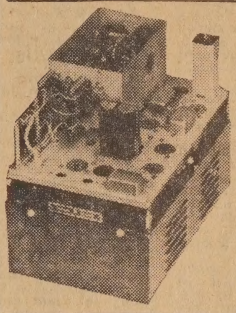
AMERICAN H.F. RECEIVER ASB4



Complete with 11 tubes, 7 6AC7, 2 6H6, 2 955 acorns. Can be altered to 144 or 280 Mc amateur band or FM band.

£5/0/0

Freight extra.



12/6

PLUS FREIGHT
BY PASS. TRAIN ONLY

Not recommended for inter-state customers.

I.F.F. CHASSIS

CONTAINED IN ALUMINIUM CASE

H.F. Oscillator, frequency approx. 200 m/c, complete with 10 high insulation octal sockets, two 7193 valves, I.F. transformer, 45 insulated carbon resistors, mainly 2 watt, 24 paper and mica condensers.

FOUR VALVE AMPLIFIER

supplied with two 7C5 valves only in brocaded aluminium case. (No power supply.)

Postage
N.S.W. 6/-

22/6

Interstate 8/6

SMALL STEP-DOWN TRANS.

240v. to 1.5v. in bakelite case suitable for lighting small globe, etc.

5/- Each

EAVY DUTY GENEMOTOR

table for conversion to AC motor (approx. sixth HP). Fully laminated. Can be used as r 12 volt generator at 20 or 13 amps. £2/17/6 .R.

NEW-AMERICAN TELEPHONE WIRE

ubber insulation with stainless steel and copper conductors sup-lied on metal reels each containing half-mile of wire. £1/15/- er reel. Case lots, each containing six reels (three miles of wire).

£10 PER CASE F.O.R.

NEW C.R.O. TUBES

SUITABLE FOR TELEVISION EXPERIMENTS, OSCILLOSCOPES, ETC.

V.C. R. 97, 6in . . . 47/6
V.C.R. 138, 3in . . . 42/6

Socket connections supplied.

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640 KING STREET, ST. PETERS, N.S.W. PHONE LA6087

ANSWERS TO CORRESPONDENTS

D.J. (South Warrandyte, Vic.) writes to us to find out if he could replace the ECC 35 with a 12AT7 and the 6X4 with a 6V4 in the Junior signal tracer.

A. Yes, D.J., these substitutions should be quite in order. The 12AT7 will most likely operate satisfactorily in this instrument without any circuit alterations. Should the gain not be quite high enough the cathode resistors could be reduced to about 3500 ohms. Of course a new nine pin socket would have to be used for both valves instead of the octal sockets specified.

S.M.L. (Geelong, Vic.) would like to know if we have published a series of articles dealing with the development of gramophone records.

A.: No, S.M.L., we have not published such articles, although we have mentioned the subject in many articles on record-playing equipment. However, there have been many books written on the subject and we suggest you contact one of the big technical booksellers, who may be able to supply you with a suitable book.

R.G.O. (Victoria) is anxious to obtain more information on the subject of binary arithmetic along the lines of that recently published by the Aerovox Corporation and as reprinted in Radio and Hobbies. He would particularly like the address of the Aerovox Corporation.

A.: We have no data available other than that already published but the address of the Aerovox Corporation is New Bedford, Mass., USA. It is possible that they may be able to help you in the matter of references, &c. You may have noticed, by the way, a couple of slight errors in the calculations, R.G.O. We didn't notice them till it was too late to make corrections.

W.R.H. (Hurstville, NSW) points out that there are a couple of errors in our recent article on binary arithmetic.

A.: How right you are, W.R.H.! We checked through the text of the article but, because of urgency, simply had the original calculations reblocked for reproduction. We didn't discover till it was too late that these calculations contained a couple of errors. Our faces are red, as well as the faces of the Aerovox people. Fortunately, most people spotted the errors for what they were and the value of the article was not seriously compromised. In fact, it proved to be one of the most popular articles we have run for a long time.

W.C. (Black Rock, Vic.) has a number of capacitors marked with a color code and wants to know if we can help him translate the markings.

A.: The capacitor color code is the same as that used for resistors, the values being expressed as micromicrofarads. If you are not familiar with the color code you may obtain a copy through our query service.

J.O'B. (Raymond Terrace, NSW) is faced with the problem of salvaging radios damaged in the recent floods and wants to know the effect of water on the various components.

A.: It is hard to positively answer in some cases, J.O'B., since much depends on the particular brand of components and their method of construction. In general, however, it is likely that resistors will not be affected, nor will valves, except that in the latter case it is possible that water may be trapped in the base if this is loose or there are any holes. Once this was dried out all should be well. Capacitors are not likely to stand more than a few days' immersion at the best unless they are of special types. These may be tested with the usual neon type capacitance tester and those that pass this test should be quite acceptable. Power transformers will cerainly need to be well dried, either in the sun or an oven and then can only be checked by connection to the mains. If they give no sign of excessive heating after a reasonable time they should be satisfactory.

A reader from Longwarry comments that we have never yet described the R T & H electronic organ. He envisages something rather like a "glorified accordeon" which could be expanded later as opportunity presented itself.

A.: We would have written to you personally had we been able to decipher your signature and address. It would help us a great deal if readers would follow the simple course of adding their name and address, together with the State in which they live, in block letters. Quite frequently, we have to direct our letters by guesswork as much as anything. As you will see, we have already included a general article on the subject but the[re] can be no guarantee that we will ev[er] get around to describing a full-sca[le] electronic organ. They are usually e[x]tremely complex devices, requiring a good deal of patience and initiative fro[m] the intending constructor. Whether it worthwhile envisaging a "glorified a[c]cordeon" type of instrument is rath[er] doubtful. Once having progressed fro[m] single-tone instruments to a type wh[ich] can play chords, one may as well g[o] the extra distance and do the job prope[r]ly. We shall see, in due course.

P.R. (North Balwyn, Vic.), sends us a circuit which he suggests might be us[e]ful for the Reader Built It page.

A.: Many thanks for your letter a[nd] circuit P.R. and we are always glad [to] receive contributions of this kind. Ho[w]ever, we feel that this particular circ[uit] does not offer any thing very new, p[lus] the fact that there are one or two poi[nts] which could be queried. For example, t[he] speaker transformer does not appear [to] serve any useful purpose and we a[re] rather puzzled by its inclusion. Also [it] is more usual to operate a leaky g[rid] detector without any additional biasi[ng] circuit, as you have shown, and to u[se] a much lower plate voltage. In fact, t[he] successful operation of the valve as a detector could be very much a matter [of] chance with circuit values and conne[c]tions as you have shown. Neverthele[ss] we are glad to see our young reade[rs] making efforts along these lines and su[g]gest that you might be able to contribu[te] something more suitable for publicati[on] at some future date.

G.S. (Bonalbo) would like us to sugg[est] some cheap radio books, which he co[uld] buy to further his studies.

A.: Unfortunately, it isn't as simple [as] might appear to recommend books of t[he] type you want. Titles appear and d[isa]appear with monotonous regularity fr[om] booksellers' stocks. A book we reco[m]mended one month might be out [of] stock a couple of months later, be[ing] replaced by one that was previou[sly] unobtainable. Then, again, different bo[ok]sellers have different books at differ[ent] times, and prices vary also. We sugg[est] that your best plan would be to v[isit] or write to your nearest technical boo[k]seller and ask for a current price list [of] books in stock. We have noted your ot[her] questions for future reference in "A[n]swer Tom".

F.J.C. (Parramatta, NSW) writes to [the] Serviceman Who Tells suggesting that [we] publish technical criticism of commerc[ial] receivers from time to time in order [to] assist the public in their choice of [re]ceivers. He also makes some caustic co[m]ments regarding the design of many s[ets] particularly with regard to the servic[e] angle.

A. Many thanks for your letter and co[m]ments F.J.C. and we will pass the le[tter] on to the Serviceman for his possi[ble] comments. However, there are more pr[ob]lems to the proposed articles than [you] might imagine and we doubt whet[her] they would be feasible. Nevertheless [we] agree that many of the criticisms wh[ich] you level at individual sets are undoubt[ed]ly true. Our experience is that, in s[ome] cases, a letter to the makers will o[ften] do more good than you might imag[ine] since no firm that wants to stay in b[usi]ness likes to hear of a dissatisfied c[us]tomer.

R.J.F. (Tanunda, SA) is anxious to [use] 3BP1 in place of a 5BP1 in the [an] Oscilloscope and wants to know if [it] would be in order. Also whether 6S[N]7 could be used in place of 6AU6's.

A. Since the two tubes use the s[ame] HT voltage there would appear to be [no] serious objection to the change o[f] The fact that your transformer is slig[htly] lower in voltage would not be serious. [In] experience suggests the wartime 6[SN]7 is rather prone to hum and noise w[hen] used in high-gain amplifier circuits [and] we are not too happy with it on this sc[ore]. However, they can be used for st[ages] which have a moderately high si[gnal] voltage applied. Electrical characteri[stics] are almost identical with those of [the] 6AU6.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

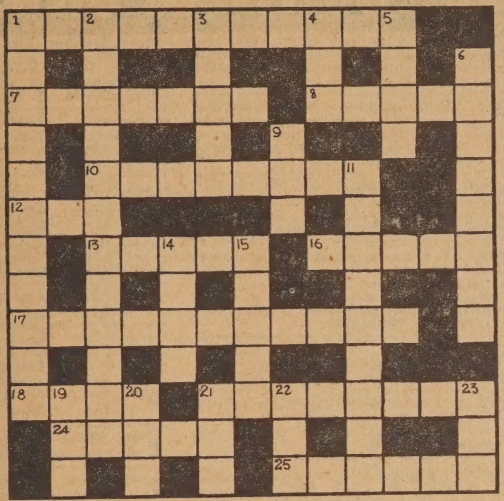
Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

THE R. & H. CROSSWORD No. 14



ACROSS

1. tranded ire.
2. rame.
3. lectromag- etic switch.
4. ight sensi- ve element.
5. dge of a ylinder.
6. ignal pply.
7. omand.
8. imits flow of urrent (pl.).
9. ype of weld- d join.
10. element alves.
11. aside.
12. Unit of heat (pl.).
13. Time signal.
14. Telegraphy (2 words).
15. Apply force to.
16. Oscillographic plot.
17. Part of valve base.
18. Explosive (abbrev.).
19. Attempt.
20. Small child.
21. Distress signal.

DOWN

1. UHF resonant circuit.
2. Radiation of RF power.
3. Sound.
4. Atmosphere.
5. Speak.
6. Type of oscillator.

Solution and further crossword next month

. (Coffs Harbour, NSW) asks about rcuit of a Handy Talkie. We published two "handie-talkie" s. The first, in October, 1947, was alve broadcast personal portable ed around early type low-gain IF rmers. In December, '47, we bed a 4-valve version of the set, more modern high-gain IF trans- rs, and this would be the better for present needs. If you have nd a transceiver, then the only we could offer is a 144 Mc ur job described in October, 1950. s of these circuits are available gh the query service.

F. (East Brisbane, Q) inquires as ere he can obtain a trigger trans- r for his R & H flash unit.

Several advertisers made these ble at the time we described the units and we suggest you look gh the pages of R & H about that for details. Nova Electrical & eering Co., of 311 Sussex St., Sydnay be able to help you.

B. (Unley, SA) requires a circuit electropsychometer and a circuit scintilometer.

We do not have any circuits of above and suggest you refer to of the overseas scientific magawhich deal more specifically with ype of subject.

.M. (Bondi, NSW) asks us to describe cuit for the reader who requires aké a "family" radio combining ent short-wave and broadcast pernce with a high fidelity audio end. We presume that your requirements ot for high-fidelity short-wave perncę but to combine these two feaso that good all-round listening good gramophone reproduction is ed. If it is proposed to use a l pickup, as suggested in your it would seem that a combinaof the front end of the "Band d with RF Stage" described in Feb., and the "Crystal Pickup Amplin the July, 1954, issue would meet needs. The .01 mfd capacitor from rm of the volume control, instead ing connected to the grid of the would be connected to the input

Last Month's Solution

T	R	A	N	S	I	S	T	O	R	S				P
	R		T		E		T			A				H
A	M	M	E	T	E	R				D				A
N		O		S			O	M	N	I	B	U	S	
S	O	S				B		O				M		
I		P		T	W	O	P	O	L	E				A
E	T	H	E	R		S			O					J
N		E		I	N	C	H		C	O	R	E		
T		R		T		O			A			C		
S	L	I	D	E		P			T	E	S	T		
		C		T	I	E	D		I			O		
D	A	S	H		O			R	O	T	O	R		
			U	N	I	T		N				S		

of the Crystal Pickup Amplifier. If a 100 mA transformer is used in the power supply of the amplifier there should be ample reserve for the tuner section. We are pleased to have had your suggestion for a family set and will keep this in mind for a possible future project.

W.J. (Port Lincoln) writes to inquire about some special equipment to test ignition coils.

A: Your query is outside the coverage of the query service. However, we feel that the method of testing, using an oscilloscope is unnecessarily complicated and we would suggest you contact the various ignition coil manufacturers for the information.

J.C. (Waitara, NSW) is interested in building a low voltage flash unit.

A: These units were described in R & H for April, May, June, 1954. However, only the June issue is still available. Copies of the circuits, parts list, some photos, and details of the case are still available through the query service.

Printed and published by Associated Newspapers Ltd., at the registered office of the company, 60-70 Elizabeth Street, Sydney, NSW.

WANTED TO BUY, SELL OR EXCHANGE

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for July issue of Radio, Television and Hobbies is Wednesday, June 8.

SELL: All new. Qual. 4½ watt amp. suit Xtal. PU £14; 5BP1 CRT's £1½, 12in Magvox. Spks. £1½, 9in Blue/White VCR516 CRT selected for TV £2½. **LB6674**, evenings, week-ends.

SELL: Printing. Special Offer:—100 Business or Visit. Cards, 30/-; 100 Letterheads, 30/-; 200, £2. Sent anywhere by mail. Do it now! **W. Hiley, 841 George St., Sydney.**

SELL: Transmitters, receivers, meters, transformers, motors, valves, &c., at bargain prices. **Suburban Radios, 334 Charles St., N. Perth. Phone BA2395.**

SELL: Belerex slide and strip projector. £5. 30 issues of R & H, '43-'55, 30/-. 90 issues of Pix £2. Complete course in Screen Printing, inc. kit and materials, cost over £22, sell at £15. **M. R. Poke, Box 11, Smithton, Tasmania.**

SELL: Snap, 3 band, f/cw, complete XmTR, 60w, £28. Foto, partics. Also other gear. **A. Shaw, P.O., South Brisbane**

SELL: R & H 5in Oscilloscope in new condition plus new 5BPI tube, £20, or exchange Voltohmyst. **54 Meeks St., Kingsford, Sydney.**

SELL: 125 copies R & H—9 years almost complete, 64 Proc. IRE, 36 Philips Tech. Comm., 22 Radio Science, Valve Data Sheets, Technical Course books. What offers? **H. Walker, 66 Johnston Crescent, Lane Cove, SYdney. JB2981.**

SELL: Adana H/S-2 Printing Machine, £25 of extra type, oak cabinet, £30. **Hester, Box 387, Leeton, NSW.**

SELL: All back issues of R & H, 1939 to date. Good condition. Write **T. Weir, 73 Gibson Av., Padstow, NSW.** 4/- per copy incl. post. Enquiries re articles, circuits, etc. Ring **UY8056** or write. Over 1000 copies in stock.

SELL: English "EW" push-button Tape-Recorder, purchased England 18 months ago, £137. Excellent condition, microphone, two new reels tape, plus crystal radio tuner adaptor for use as radio. £80, offer. **14 Powells Rd., Brookvale, Sydney.**

SELL: 16mm H. and Heath Sound Projector. Brand new. Cash for £55 off list price, complete. Forced sale. **Badger, 7 Cecily St., Leichhardt.**

SELL: Acos GP40, complete and additional GP20LP hd. for sale, £6. **FB3271**

SELL: Telefunken radio compass receiver, Telefunken turret tuned wave aircraft receiver, 1082 receiver 813, 809 valves. Many 6 and 12 volt receiver valves. 24 volt relays, rotary converters. All very cheap—no reasonable offer refused. **F. J. Ulrich, 44 Otterie Grove, Ivanhoe, Vict. JX4492.**

SELL: Paton VCT, perfect order. Intercom. set with 2 PM Speakers £10. **LX4084.**

SELL: Hi-Fi Goodman type vented Thorens Player, Decca twin Rola 12UX spkr. Push-pull, 3 units tuner, £100, offer. **XW7227.**

SELL: Radio Compass, converted AC with speaker, £15; FS6, brand new, £5; 1196 Receivers (6 x 6.3V valves) 50/-; Transmitters, 20/-; Genemotors 28/230, 40/-; brand new 26/250 with separate 6.3V/3.2 amp, 50/-; 110V Transformers, 3/-. **Box 17, Kingsgrove.**

SELL: 120 copies R & H, Vol. 7 to Also Oscil. Test Insts. **Mackay, UI Ext. 464 or 288, Sydney.**

SELL: Back nos. R & H 2/- ea., po **A. J. Cox, 13 Glover St, Belmont,**

FOR SALE: No. 11 Transceiver, c station, ex. work ord. **JJ3377. Syd**

FOR SALE: Ferris Hi-Fi Home M System, new, offers, **JF4596, Syd**

FOR SALE: 6V vibrator power su self contained, for car radio, 70/- electromag speaker in solid box, cheap 2 and 3 gangs. **GPO, 4853, SY**

FOR SALE: All copies Radio and bies since August, 1944. Best **Herb Harrison, Ariah Park, NSW.**

WANTED: Radio Service Man Vols. 1, 6, 8 and 9 in good co Offers to **E. Smoderek, 16 Chrysler Croydon Pk., Adelaide, SA.**

WANTED: Two control boxes and cuits urgently required RT-34/APS-13 Transceivers. **Fitzgerald Manning Street, Milton, Brisb Queensland.**

WANTED: Copy March issue, 1941 tralian Radio World. **J. V. Fra 1061 High Street, Armadale Victoria.**

ENGLISHMEN in Melbourne, B Newcastle, Adelaide and Perth car and "Grundig" or similar Reco offered interesting and profitable ho Write: **A. G. van Steensel, 13 Thorn St., Darling Pt., Sydney.**

ORGANS (Electronic). See advert ment, page 95.

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